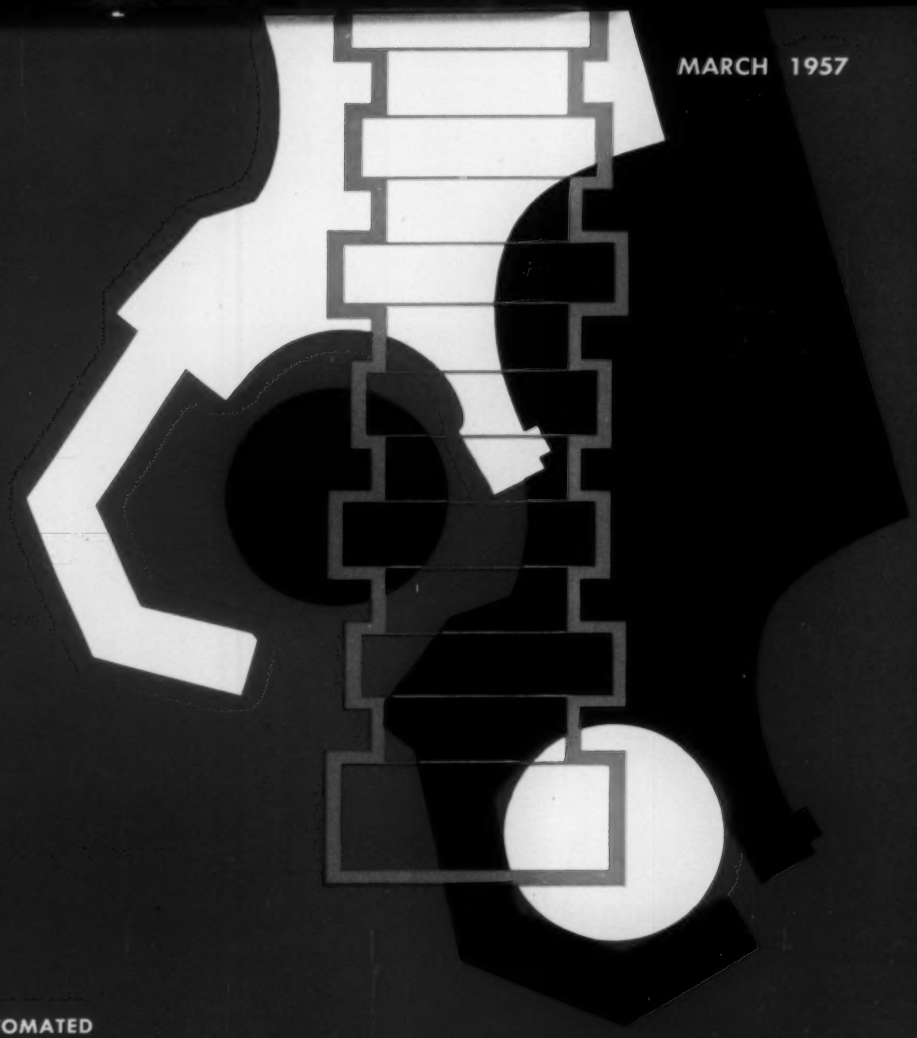
AUTOMATION

MARCH 1957



AUTOMATED

Camshaft Machining

The Magazine of Automatic Operations

- What Degree Automation?
- Measure Your Quality . . . Automatically
- Developing Large-Scale Automation
- Punched Card Roll Positioning

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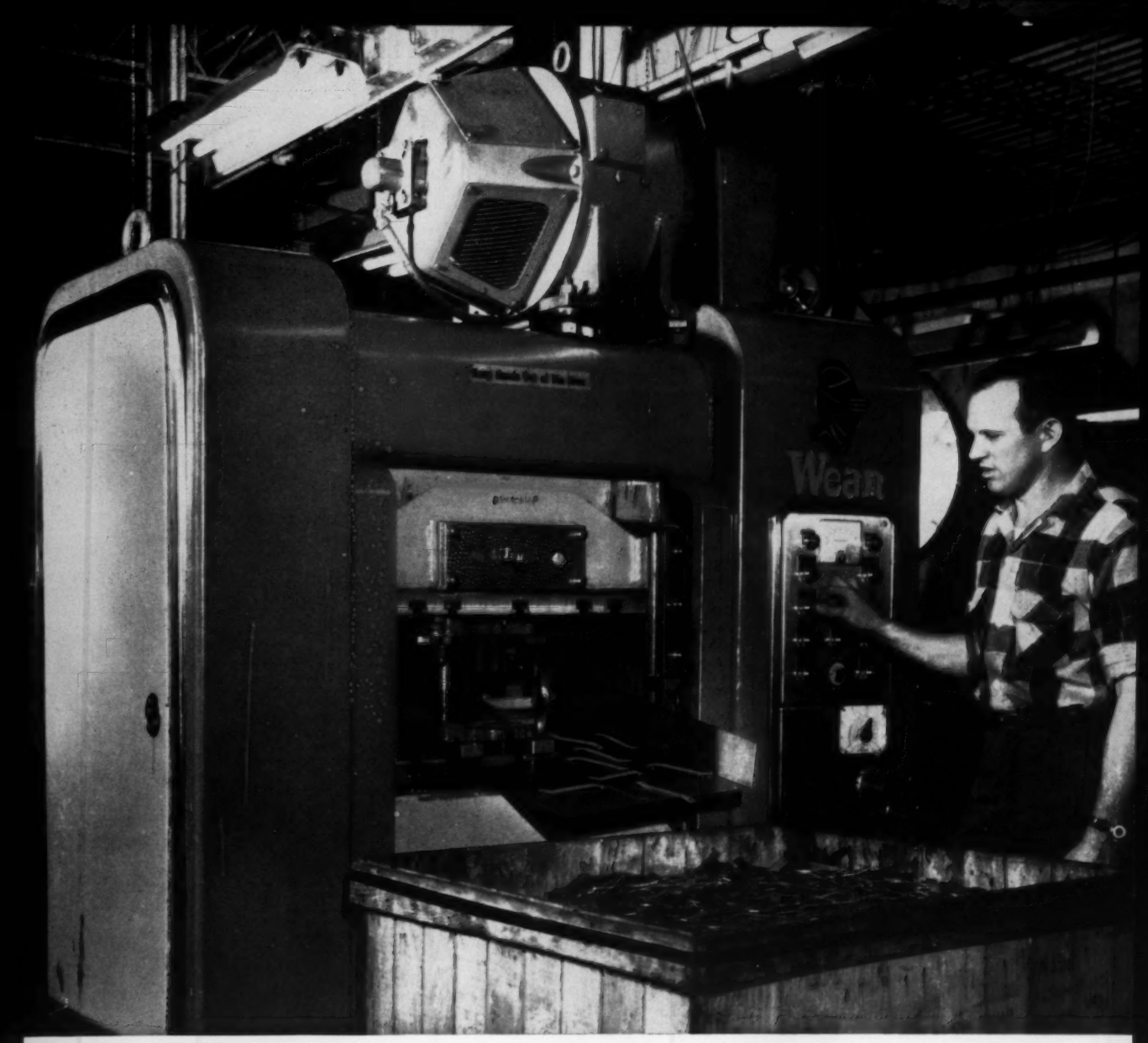
A PENTON PUBLICATION



Is the Wean "Flying Press"

the fastest press in the world?

WE THINK IT IS. While our top speeds have stayed around 600 strokes per minute on the "flying press," the size of piece is not restricted to washers and the like which are made on other high speed presses.

For example, where conventional presses rarely can process more than 100 feet of metal per minute, the "flying press" has performed at speeds in excess of 300 feet per minute.

One new model, for instance, blanks automotive assemblies 8 feet long at 45 per minute.

Yet, the "flying press" has other major advantages for you. Despite its revolutionary construction, it requires up to 20% less maintenance than other presses — it has no brake or clutch to wear. And, because of almost perfect dynamic balance, the press can be floor mounted.

We could write a book about the features of the Wean "flying press" — in fact we have. It's soon to be released . . . and it's yours for the asking. Write to the address below. We will mail your copy of the Wean "Flying Press" brochure as soon as it comes from the printers.

Wean Equipment Corporation

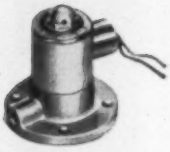
CLEVELAND 17, OHIO

Circle 551 on Inquiry Card

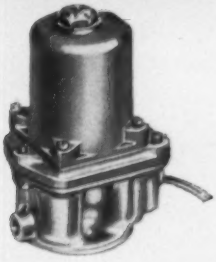
NEW Ross Starline

air control valve series

NEW long life



WHITE STAR
SPOOL SOLENOID



GOLD STAR
OIL-IMMERSED SOLENOID

BLUE STAR MV

BLUE STAR TD

BLUE STAR WV

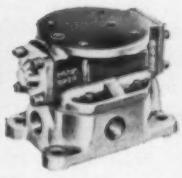
NEW match any head to any valve body!

STRAIGHTWAY
NORMALLY
OPEN

STRAIGHTWAY
NORMALLY
CLOSED

3 WAY
NORMALLY
OPEN

3 WAY
NORMALLY
CLOSED



3 WAY
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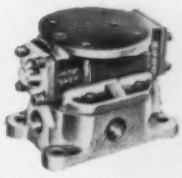
OPEN



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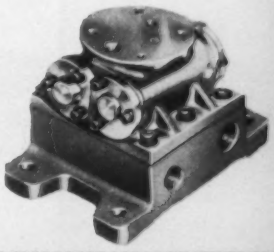

4 WAY

Tests indicate a trouble-free life of over 25 million cycles for valves with the spool solenoid pilot section, and *more than 40 million for all other Starline* valves shown.

Heads and bodies are completely and instantly interchangeable. Sizes from ¼" to 1¼". Even *more* Starline models coming later. Write for Starline data file.

A Galaxy of New Air-Control Stars Are Coming Your Way From

Ross OPERATING VALVE COMPANY

131 EAST GOLDEN GATE AVENUE • DETROIT 3, MICHIGAN

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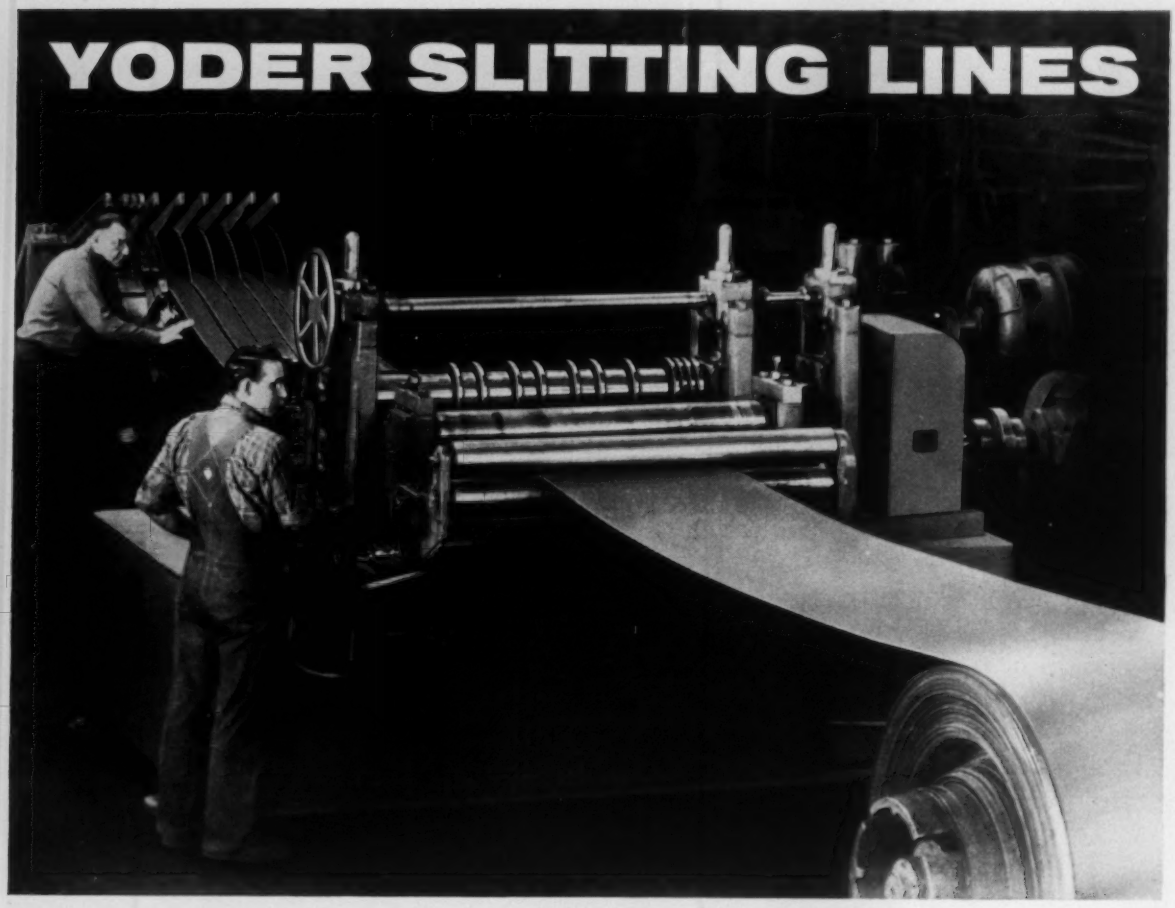
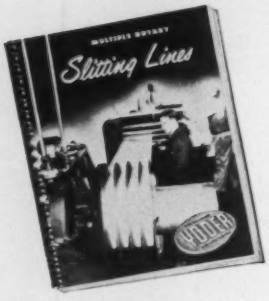
YODER SLITTING LINES



pay big dividends working only one day per week!



The Yoder Slitter Book **is a comprehensive treatise on slitter operation and economics, with time studies, cost analyses and other useful data. It is yours for the asking.**

In one plant, two Yoder tube mills and about 50 punch presses are being supplied with slit strands by one Yoder Slitting Line operated an average of only *seven hours per week.*

In another plant, a Yoder slitting line, *operated from six to eight hours per week,* is supplying two intermittently operated roll forming machines with total requirements averaging 100,000 feet per week.

These typical examples demonstrate, first, the big potential output of a relatively small, inexpensive Yoder standardized Slitting Line and, secondly, its big profitability. Assume production of only 35 tons of slit strands per 8 hour shift, one day per week, and the total per year would be 1750 tons. Estimating the saving in slitting cost at only one-half cent per lb., the total annual saving would be $17,500.00.

Besides the big convenience of doing your own slitting, such savings will often repay the investment in a few months.

THE YODER COMPANY 5526 Walworth Avenue • Cleveland 2, Ohio, U.S.A.

ENGINEERING YODER MANUFACTURING

ROTARY SLITTING LINES

COLD ROLL FORMING MACHINES

ELECTRIC-WELD PIPE AND TUBE MILLS

MARCH 1957
Vol. 4—No. 3

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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automation outlook

REFLECTION OF GROWTH

". . . evidence of this growth is reflected in figures recently released by the American Society of Tool Engineers, predicting that annual capital equipment procurement for automated equipment will jump from 18 per cent in 1956 to 22 per cent in 1957 for all plants, large, medium and small. Most of these integrated operations will utilize automatic production gaging in one or more of its basic forms—in-process, post-process, final inspection and overall monitor control. A further breakdown of these automation procurement figures shows that in the area of least penetration, medium plants, the predicted purchases will be at a 30 per cent level in 1956-57. Maintenance of these high volumes will require that automatic measurement's capabilities, characteristics and basic features become common knowledge among the automation engineers—the systems designers, builders and operating-maintenance men. . ."—*W. Fay Aller, vice president and director of the Autometrology Div., Sheffield Corp., see page 52.*

IMPACT OF AUTOMATION

". . . during the last few years, it has become evident that this 'continuous flow' concept could be applied to the entire business; not only in the manufacturing area, but also in the offices to the paper working systems, and in the field to the distribution techniques. With this realization, the full impact of automation on the business became evident to management. Professional management began to see in the accomplishments of manufacturing men a challenge to operate an entire business on a continuous, automatic production basis. . ."—*P. H. Alspach, manager, Equipment Development Laboratories, General Electric Co., see page 67.*

POINTS OF CONCERN

". . . the degree to which we automate our plants and processes depends largely on product or workpiece, production schedules and available capital. Each engineer is concerned with the degree of automation at some point or points in plant production operations. . ."—*Edward L. Behringer, Micromatic Hone Corp., see page 40.*

MANAGERS OF INFORMATION

". . . it is the programmer, or in the new names that have been proposed, the *applied logician, information engineer, or information machine specialist,* who has the responsibility for serving as a manager of the new information handling systems, soon to be equivalent in information handling power to tens of millions of human beings, as we have seen. He is not just a systems and procedures man, or accountant, or engineer, or even mathematician, although he may have any of these qualifications as a background. He must also have similar requirements with respect to the new information machines as does a present day manager with respect to a persent all-human information system. . ."—*Dr. John W. Carr III, assistant professor of mathematics, University of Michigan.*

MORE PRECISE PRODUCTION

". . . the greater endurance will be developed by better original design, more precise production through automation, and by the development of new materials. Already we are using a considerable amount of automatic assembly as well as fabrication . . . "—*Victor G. Raviolo, director of advanced product study and engineering research, Ford Motor Co.*

AUTOMATION

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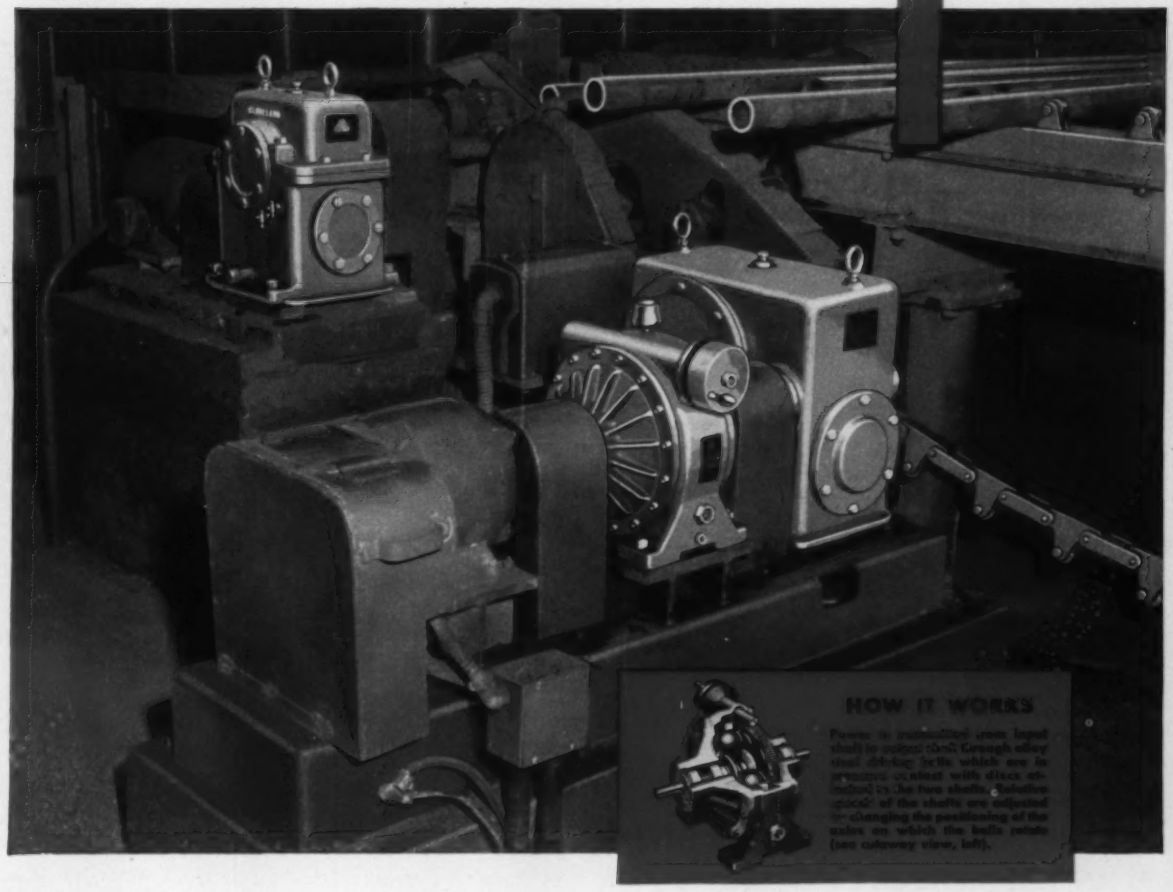
BPA NBP

Hot pipe conveyor travels at precision pace set by CLEVELAND Speed Variator

Drag-type conveyors utilizing Cleveland Speed Variator Size 6K4 Series 1. Driving Cleveland Double Reduction Worm Gear Size 051D Series F, ratio 900:1.



THIS hot pipe conveyor produced by York-Gillespie Mfg. Co. is a good example of the precision engineering applied in steel mill operation today. Conveyor speed has to coincide exactly with the speed of other operations on the line—has to adjust to the pace of production anywhere in the line. That's why a Cleveland Speed Variator is on the job!

Being infinitely variable, the Speed Variator gives stepless speeds over its full 9:1 range—from ⅓ to 3 times input speed. Output speed is adjusted manually by a hand wheel mounted on the Variator—but could be regulated automatically by remote controls of various types.

The Cleveland Speed Variator provides these major advantages: 1. An extremely compact unit with input and output shafts in line and rotating in the same direction; 2. Almost any input speed up to 1800 rpm can be used—either clockwise or counterclockwise rotation; 3. Rated for constant horsepower output over a 9:1 range, or for constant output torque with a 6:1 range; 4. Infinitely variable over the entire speed range; 5. Rapid response to speed change, precise adjustment, and accurate maintenance of speed settings; 6. Long life and minimum maintenance due to absence of belts or complicated linkages; 7. Ample bearing support for overhung pulleys on either input or output shafts.

This revolutionary variable speed drive is available in eighteen standard types and sizes. For detailed description of the Cleveland Speed Variator with photographs, sectional drawings, rating tables and specifications, write for Bulletin K-200.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3265 East 80th St., Cleveland 4, Ohio

Sales representatives in all major industrial markets. In Canada—Peacock Brothers Limited.

Circle 556 on Inquiry Card

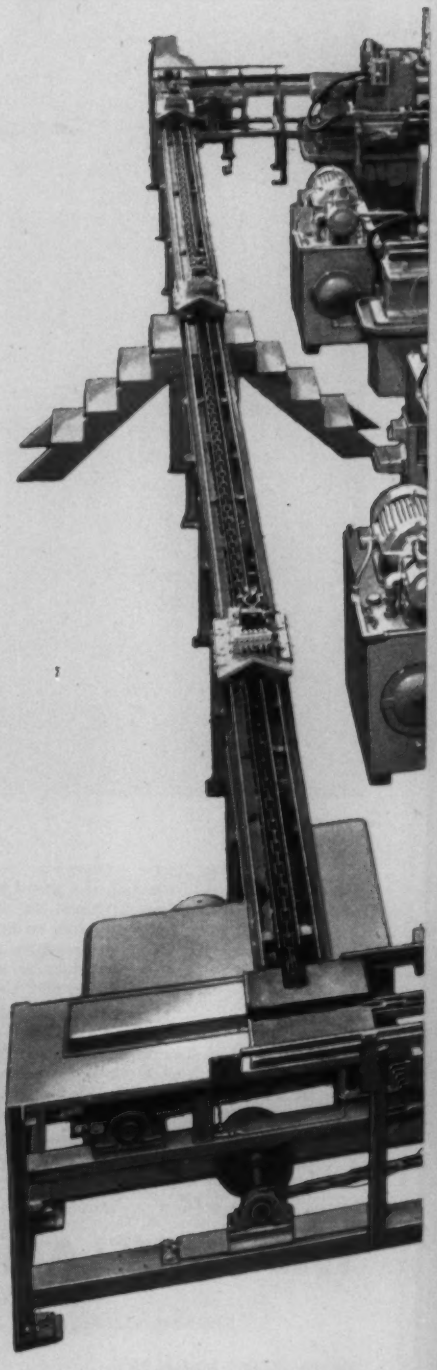
New Snyder Special Transfer Replaces Automation in Processing Forged Steel

Special Features of Snyder Machine No. 55-44

1. Production: 146 pieces per hour.
2. 26 Stations: 28 Operations per piece: 2 milling, 1 sawing, 4 hollow milling, 3 reaming, 1 countersinking, 10 drilling, 5 spotfacing, 1 threading and 1 tapping.
3. Palletized fixtures each carrying two parts.
4. Parts quickly and accurately clamped and located and unclamped by combination torque wrenches and hydraulically operated mechanisms at Stations 1 and 26.
5. Ten individual base segments provide maximum flexibility for future part design changes.
6. Ample room between segments for tool changes and maintenance.
7. Motorized fixture return conveyor with fixture washing unit.
8. Ample chip and coolant facilities.

Standard Features of Snyder Machines

1. SNYDER SELF-CONTAINED UNITS and other units equipped with hardened and ground ways.
2. Threading and tap heads equipped with individual leadscrew spindles.
3. Minimum downtime for tool changes because spindles are arranged for pre-set cutting tools.
4. Standard and special parts interchangeable for speed and economy in maintenance.
5. Motorized automatic lubrication system for all moving parts.
6. Construction to J.I.C. Standards throughout.
7. Master Push Button Panel and Light Console at Station 1.
8. Each unit equipped with its own push button control station for ease of tool setup and manual operation of unit.
9. Electrical interlocks and full depth circuit throughout.
10. Panels equipped with SNYDER CIRCUIT SLEUTH.



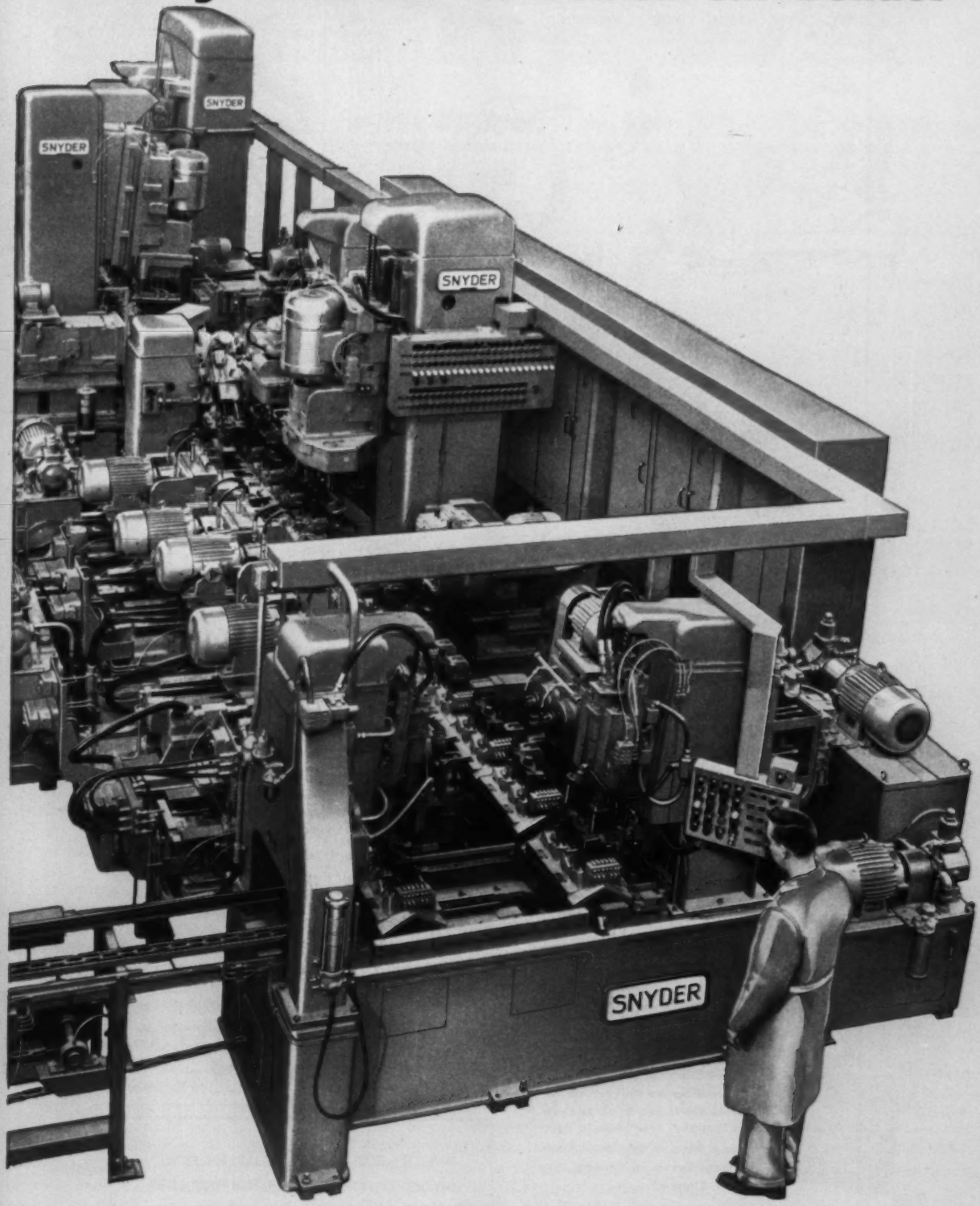
SNYDER

TOOL & ENGINEERING COMPANY

3400 E. LAFAYETTE • DETROIT 7, MICHIGAN

32 Years of Special Machine Tools with Automation

Several Semi-Standard Machines with Steering Knuckles for British Car Builder



Circle 557 on Inquiry Card

"Gadgeteering"

Kissin' Kin to

AUTOMATION

Webster defines our slang expression "a gadget" as "a device for doing something; especially, a part of machinery." It's kissin' kin to automation.

Many of the marvels in America's production lines are "gadgets" dreamed up by men tired of doing things the hard, slow way.

We manufacture air-powered work units to make the job of the methods engineer easier. With these integrally controlled power units he can eliminate many cams, gears, levers and mechanical linkages and perform an almost unlimited range of repetitive pull, push or lift motions, smoothly, economically, and in perfect synchronization with any related movement. With them he can convert existing machinery into faster, automatic units, or he can build in his own tool room low cost, highly efficient special purpose machines.

Like to know more?

These free four-color booklets will give you a quick picture of what Bellows "Controlled-Air-Power" work units can do for you. Ask for Bulletins BM-25 and ML-3. Address: Dept. AU357, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

The Bellows Co.

AKRON 9, OHIO

MANUFACTURERS OF "CONTROLLED-AIR-POWER" DEVICES FOR FASTER, SAFER, BETTER PRODUCTION

7668

Circle 558 on Inquiry Card

AUTOMATION news

Today's events and developments in the field of automation

Training Program Prepares Engineers For Responsible Role

FOLLOWING an industry-wide survey undertaken last summer by a task force of Western Electric engineers and training specialists, the Western Electric Co. has established a broad new engineering education program. The program is designed to keep its working engineers abreast of the latest developments and implications of their individual fields. Three "Engineering Training Centers" will be organized by the company in the New York, Chicago, and Winston-Salem areas for engineers to take full time courses while temporarily detached from their regular assignments. All new engineers hired by Western Electric will take part in the program, beginning 4 to 6 months after they start work. The new engineer will take a 9-week series of introductory courses, followed by a series of general development courses about a year after he has joined the company. The second series of courses will last about 10 weeks.

Experienced engineers will receive more advanced development courses on the basis of their qualifications, need and capacity. These courses will relate to their specialized fields. Besides being designed to meet the engineering challenge of tomorrow in the strictly technical sense, the educational program was organized to help equip the engineer for his increasingly responsible role in a technological civilization. In addition to subjects based on the physical sciences, including electronics, manufacturing and communications, courses will be offered in human relations, the sociological impact of engineering and new horizons in engineering.

DESCRIBED as "the most modern and efficient union headquarters in the world," the attractive International Association of Machinists' new Washington offices reflect the growth and "big business" aspects of the union movement. With an organization of more than 900,000 members, the union has established a mechanized data handling system which processes all basic records on members and their dues payment. Remington Rand equipment has resulted in more efficient service to IAM's members. The union reports that with machines, the amount of work at the local lodge level has been reduced by approximately 70 per cent. The union has also been able to reduce its central office staff from 148 to 96 employees.

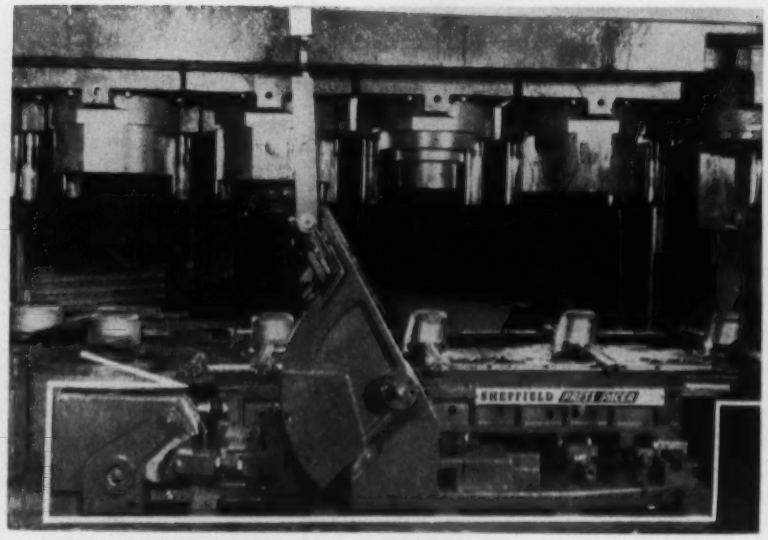
Pallet Standards Prepared —Industry Asked to Comment

TENTATIVE draft of proposed standards for pallet sizes has been developed under the cosponsorship of the Society of Industrial Packaging & Materials Handling Engineers and the American Society of Mechanical Engineers in accordance with procedures of the American Standards Association. The draft presents data not previously published and is being circulated for comment by interested parties. Comments should be directed to **J. E. Wiltrakis**, chairman, B-69 Technical Committee, c/o Society of Industrial Packaging & Materials Handling Engineers, 111 W. Jackson Blvd., Chicago 4, Ill. Copies may be obtained from the same address.

The committee which prepared the draft has suggested that the number of pallet sizes be reduced from the hundreds now in general use to ten standard sizes. The ten suggested sizes of pallets are believed by the committee to make maximum use of shipping space and at the same time simplify materials handling in warehouses, industrial plants and elsewhere. In particular, standards would allow greater utilization of trailer truck and rail car area and cube. The standard is intended to cover only noncaptive pallets, that is, pallets

whose cycle of use extends through one or more military, corporate, or private enterprises and usually includes transportation by a common carrier.

CONTINUING its annual program of aid to education, the Du Pont Co. has made available a fund of more than $1 million for grants to 122 universities and colleges. The major portion of the program is primarily aimed at the improvement of teaching of subjects which contribute to scientific and engineering education in universities, colleges and high schools. The remainder of the program contains grants for fellowships in science and fundamental research.



PORTABLE mechanical transfer mechanism recently introduced by the Sheffield Corp. enables manufacturers to convert standard presses to automated units. The device is mounted on the bed of the press and is actuated by a lever arm attached to the ram. The standard model "Press Pacer" has a transfer distance adjustable to any increment within an 8 to 36-inch range. Essentially the unit consists of a pair of transfer rails on which are mounted opposed fingers that transfer stampings between stations of a single press or between a series of presses. The pickup fingers are easily changed to accommodate different parts.

Elevated Temperature Drawing Gives Bar Unique Properties

STEEL bar products with a unique combination of physical and mechanical properties result from a new process development of the La Salle Steel Co., Hammond, Ind. The process has been named "e.t.d." (elevated temperature drawing). It results in steel bar with dimensional tolerances, surface finish and machinability characteristics generally associated with cold finished bars, but with strength properties normally developed by a standard quenching and tempering cycle. Among applications for which the new steel is finding use are spindles, shafts, splines, gears, collets, arbors, bushings, pins, cams, studs, screws, valves, rotors, guides and similar items. The product is offered commercially with guaranteed Rockwell C values of 30, a minimum tensile strength of 140,000 psi and a minimum yield strength of 125,000 psi. It machines about 25 per cent faster than annealed alloy steel and as much as 100 per cent faster than alloy steel heat treated to the same strength level. Inherent in the manufacturing procedure is a uniformity of property from heat to heat, bar to bar and across the diameter of the bar which is not normally available in quenched and tempered bar stock.

The new combination of properties of the bar product offers several advantages in many applications, including the following: Lessens the dependence on strategically scarce alloys; makes possible a combination of properties not economically attainable by present methods; eliminates heat treatment and subsequent operations; combines high strength with improved machinability; and direct production by machining operations of parts which have before required multiple and often costly operations.

Cleats for Conveyor Belts

MOLDED neoprene screw-on cleat, available from T. H. Hinchcliffe, Pasadena, Calif., will convert any conveyor or elevator belt into a cleated belt. The neoprene cleats are attached to the belt by means of flat head machine screws secured to threaded metal inserts vulcanized in the base of the cleat. Originally designed for the food industry, the new neoprene cleats are being used successfully in grain and feed mills, clay processing plants, vegetable oil mills, fertilizer and rendering plants, and on harvesting machinery, wood chip elevators, etc. One of the advantages of the cleat design is the ease of changing width and height of the cleats and the possibility of transferring cleats to replacement belts.

Special Printer Output Matches Computer Speed

READOUT devices to match the calculating speeds possible with a computer are a much sought after goal. Burroughs Corp. has developed a printer-plotter for the Ballistics Research Laboratories which can form an image on paper in three-millionths of a second.

Ordinarily computer information is read out through a buffer, such as a magnetic tape storage system, that holds the information until conventional printers can print it. Used in connection with the Ballistic Research Laboratory computer, the printer-plotter actually operates as a high speed page printer in translating the computer's words into printed plotting positions and alphameric information on continuous rolls of ordinary page-width paper at a speed of 300 plotting points per second. It also automatically prints legends and graph

Circle 559 on Inquiry Card→

For quickest service in solenoid valves, write for Skinner's Nationwide Stock List

The Skinner Nationwide Stock List covers the most universally applied Skinner Solenoid Valves for air and hydraulic service. All the valves listed are carried by every Skinner Stocking Distributor in the U. S. From his stock, your own local distributor can quickly meet your requirements. So for your own convenience, we urge you to write for this nationwide stock list of Skinner Solenoid Valves.

Skinner Stocking Distributors are located in all key industrial areas. If you have a solenoid valve problem, talk to the one nearest you. Tell him your requirements in regard to port sizes and locations, voltages, pressures, temperature conditions, capacities and mountings. Let him show you how easily he can select the valve you need.

For complete information on Skinner's line of exceptionally long-life 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 323

Skinner Solenoid Valves are distributed nationally

SKINNER ELECTRIC VALVES

CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION

NEW BRITAIN CONNECTICUT

105 EDGEWOOD AVENUE

lines while translating and printing the computer's output.

The unit uses a three-stage operation to produce its printed record. Characters, plotting positions and alphameric information first take the form of a pinpoint pattern of electrostatic charges on the surface of low-cost paper as they come from the computer. Next, the pattern is made visible by passing the paper through a dry ink bath. Tiny amounts of the ink cling to the electrically charged pinpoint areas. The paper then rolls across a temperature controlled hot plate that fixes the ink permanently, making it fade-proof and smudge-proof.

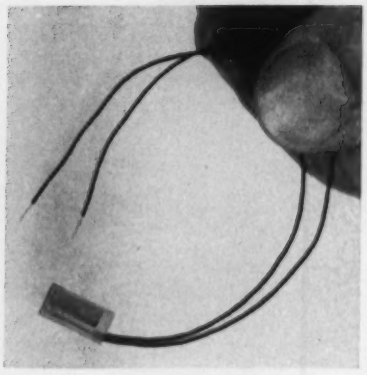
The pinpoint pattern is made by passing short bursts of electric current through selected wires in a small matrix. Selection of the proper wires forms successive characters or numerals.

1956 In Retrospect— Automation Comes of Age

By R. W. BOLZ
Editor

IN REVIEWING technology and industry in 1956 and the early part of 1957, one thing stands out—automation has come of age. Supporting the pioneers who have understood its potential from the first, automation entered upon its maturity not in the sense of an infant slowly growing into adolescence—but rather as an adolescent being stripped of humiliating swaddling clothes. Automation must no longer defend itself as a new theory grown from questionable and untested dreams of science-fiction writers. Industry is not as concerned with "Should we automate?" as it is with "How can we automate?"

During these last few years automation has been a much discussed subject. Before meetings, conventions, Congress, parliaments, etc., there arose industrialists, engineers, statesmen, labor leaders and just plain politicians in a profusion of numbers to interpret automation. All things considered, the value of contributions, as is usually the case, ranged from "nothing" to "a great deal." However, considering the unanimity of opinions concerning the beneficial value of automation to the future of America, it appears that the variety of descriptions and explanatory statements merely reflected an exaggerated communication problem.



LINE of new tape-on surface temperature resistors has been introduced by Trans-Sonics Inc. The sensing element is applied to a surface by applying pressure to a small piece of Mylar tape. Having an output up to 5 volts without amplification, the resistors can be used directly in a commutation circuit to modulate standard telemetering transmitters. The units are available in various ranges from —300 to 400F and are furnished with two 6-inch long fiberglass-covered constantan leads.

During 1956 co-ordination of effort has been a notable contribution toward solution of the communications problem. Within the company or corporation structure, co-ordination of efforts in so fundamental an activity as automation must come from the top. Titles such as Director of Automation, Automation Manager, Vice President for Automation, are no longer uncommon. Progress in co-ordination between industries has also been in evidence. The Radio-Electronics-Television Manufacturers Association and National Machine Tool Builders' Association have established contact, and plans have been made for a co-ordinated approach to automation problems affecting both industries. The Aircraft Industries Association has also been active with RETMA in discussing the problems related to certain facets of automation such as numerical control of machine tools. In other cases there is a trend toward closer engineering co-operation between conveyor manufacturers and machine tool builders.

In this coming-of-age year, obviously many of the earlier developments and trends have continued to progress. Laboratory developments of a year ago are mushrooming throughout industry. This is particularly true since progress in some fields cuts horizontally across industry lines, giving momentum to the advance of a wide variety of endeavors. An example would be developments of solid-state devices in the area of automatic control. Within the limits of economic practicability, large computer installations are increasingly being used for inventory control purposes. With improved knowledge of feeding, orienting, sorting and fastening techniques, automated assembly has advanced in many fields, especially electrical and electronic device manufacture. Concentrated effort has been made to improve subassembly and miniature assembly techniques, particularly by utilizing indexing table arrangements.

Developments within certain industries testify to the growth potential inherent in automation; for instance, the state of the chemical process industries in automation was further advanced by the availability of many types of process stream analyzers. Now, determination of stream chemical analysis is becoming a reality; this added to stream measurements of pressure, temperature and flow adapts laboratory procedures to production facilities.

The automotive industry has continued in the spectacular with introduction of automatic welding into an automated frame line and numerous automatic wheel assembly systems, plating lines, engine assembly lines, and automated machining, stamping and foundry installations. It should be noted though that the year 1956 proved that the automotive industry is neither the sole index of the American economy nor the primary factor in automation technology. The slight downward trend in sales activity in the industry was not reflected in the general economy nor in automation growth.

Packaging has become so integrated into the modern automated line that it has become necessary

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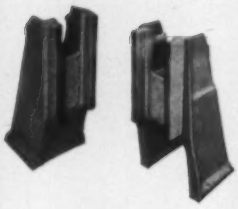


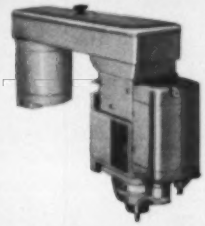
Columns

Circular Base Top

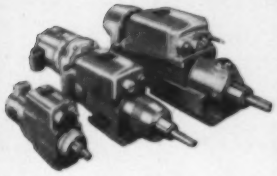
Index Table Support

Pedestals

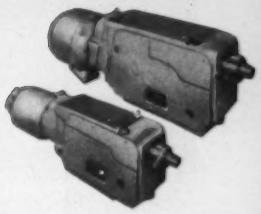
Unit Mounting Adapters



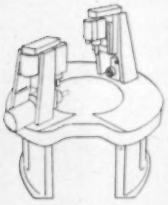
Integral Motor Mounts

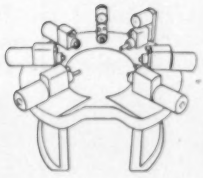


Automatic Air-Hydraulic Drill Units

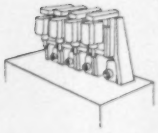


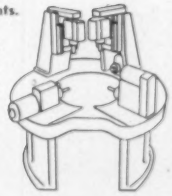
Automatic Cam Type Drill Units





Four of the many machine setups possible with Hartford Components.





HARTFORD SPECIAL now offers a complete high production automatic processing machine in knock-down form, ready for assembly on your floor. The production-tested components and elements illustrated above are available *from stock*, and are the same standard machine equipment from which Hartford's line of complete automatic drilling and tapping machinery is made.

For the plant that is plagued by model changes or setup costs, these preengineered components can offer unlimited time and cost saving. "Building block" construction allows you to build a production machine to your own design or needs on the spot, when and where you need it. Call in Hartford now, and take advantage of our offer to produce better products at lower cost through better methods.

Hartford also makes automatic Thread Rolling Machines, Special Machinery and the world famous Super-Spacer.

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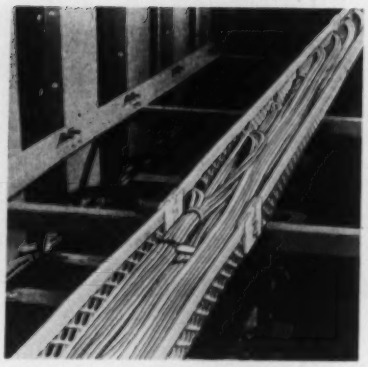
to place major emphasis on the machinery required. Automatic filling, checkweighing, wrapping, counting, sorting and inspecting are no longer end of the line functions, but are being integrated throughout the line. It has been amply demonstrated that the packaging industry is following the automation trend and no producer need be concerned about the source of equipment when the time arrives to extend automation to this function.

Recent studies have highlighted the underlying cause of the steadily declining profit margins of numerous metalworking companies—a paradox in view of the general industrial boom. The reason appears to be rooted in obsolete equipment. Machine tool builders have recognized the ready market in the metalworking industry and have been supplying the need with standard automatic cycling machines equipped with standard handling devices. Magazine, escapement, loader and eject mechanisms are timed into the machine cycle. Developments in this direction appeal to large and small companies alike who are anxious to recapture their profit margins and assure success in highly competitive industries.

Developments in materials handling have been such that the overall system more and more must be considered an integrated unit. Some of the more spectacular advances made in automation have followed the recognition of an integrated handling function. Discussion concerning the use of standard or specially designed materials handling equipment reflects the theme of 1956—How best to automate, not if to automate.

Activity in expansion or improvement programs has led to a need for detailed answers to automation problems involving equipment, methods and processes. The scope of the activity can best be appreciated by studying Commerce Dept. statistics—total new plant and expansion in 1956 ran roughly to $35 billion of which some two-thirds was allocated to machinery and equipment. A significant part of the $23 billion in machinery and equipment went into automation installations.



EXPANDED metal trough in various widths and lengths is used to provide for continuous support and protection of instrument tubing. Manufactured by the Instrof Div., T. J. Cope Inc., Collegeville, Pa. with a wide range of fittings and accessories, the troughs permit rigid assembly at the job site to conform to installation requirements.

Fast Induction Heating

ULTRA FAST induction hardening is possible with new line of induction heaters developed by the Radio Frequency Co., Medfield, Mass. The equipment uses powdered core output transformers.

As an example of the need for fast induction hardening, a certain application required that a knurl on the end of a spring-shackle bolt be hardened to a depth of 0.012-inch without hardening or heating the rest of the bolt. Ordinary induction heating techniques could provide a minimum heating time of 1 second with a 20 kw unit—necessitating the use of a cooling stream of water to prevent the entire bolt from heating.

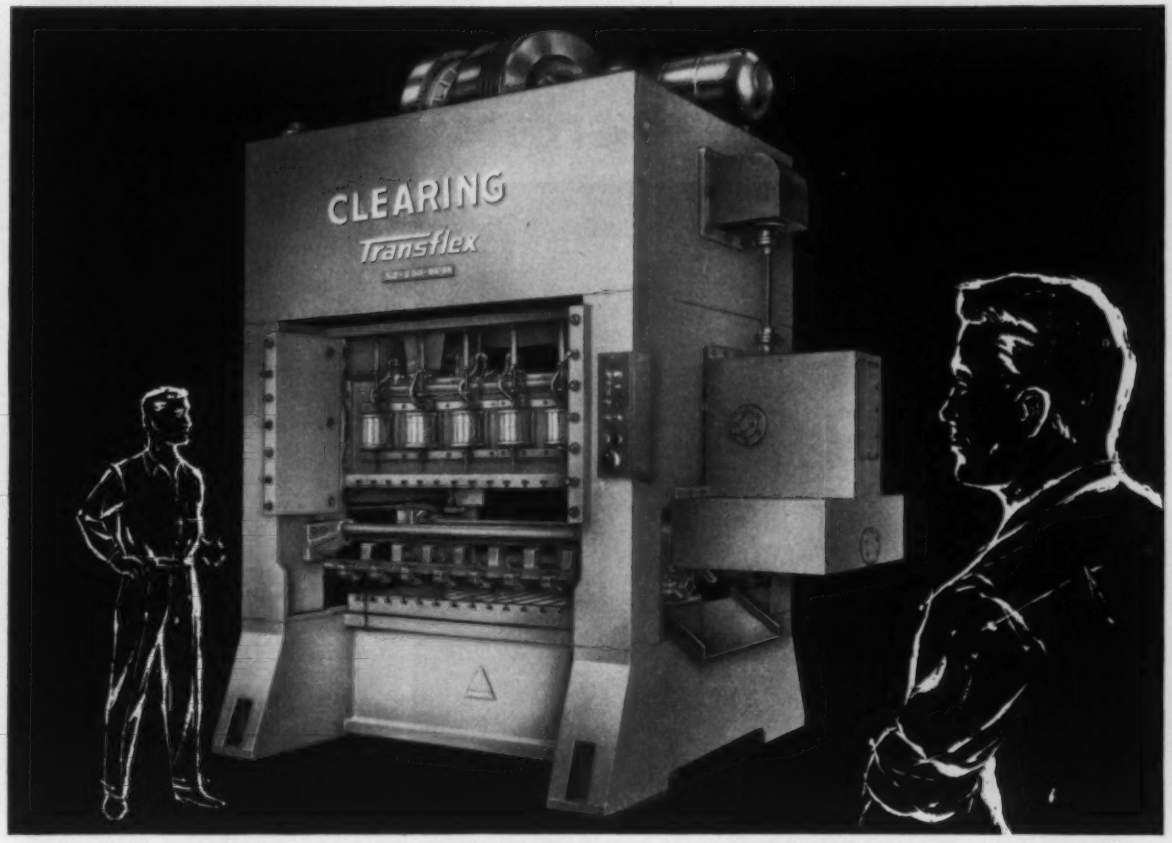
With fast induction hardening equipment, the requirements of the example can be met with a 10 kw unit and accomplished in 0.25-second. Because heating is accomplished so rapidly, no special quenching is required as the residual cold of the bolt provides the necessary quench.

FORMERLY process engineer for the Cleveland Worm & Gear Co. and its affiliate, the Farval Corp., **John R. Dingle** has been appointed vice president in charge of manufacturing for both firms. **Sidney L. Eastman,** former chief engineer of the Cleveland Worm & Gear Co., has been appointed vice president in charge of engineering.

Automatic Propulsion Control

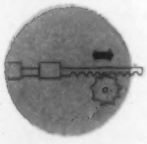
PROPULSION controls developed by Westinghouse Electric Corp. for three ice-strengthened cargo ships will incorporate magnetic amplifier regulators to replace the rotating regulators or electropneumatic devices normally used for this service. The units control the propulsion motors, and adjust the operating characteristics automat-

EMPLOYEES of North Electric Co., Galion, O., have been provided with an automatic cafeteria that can serve over 500 employees during a lunch hour period. Actually offering a 24 hour a day service, ten automatic venders supply a variety of 33 foods and beverages. The supplying of hot or cold foods and beverages from machines is possible because of the recent progress by the packaging, processing and automatic merchandising industries—progress which marks the North Electric Co. cafeteria as a forerunner of things to come. The automatic cafeteria is so organized that the company is in effect kept out of the food and feeding business entirely. Their daily contribution consists of providing the space, tables and chairs, 8 hours' custodian service, utilities and piped-in music to add to the enjoyment of a tasty meal.



Press automation for small parts at moderate cost?

Yes, with a Clearing Series-S Transflex Unit



Operating station center-distances are variable.

Feed fingers readily adjust for different sizes of parts.

Die cushions are adjustable right to left.

Knockout positions adjust right to left.

Transflex—transfer feeding plus the ability to produce a variety of parts—has now been applied to Clearing Series-S presses. These moderate priced straight side presses are produced in capacities from 75 through 300 tons.

These presses have all the major adjustment features typical of all Transflex units. In addition, provision is made for fast detachment of the finger bars so that die changes are quick and easy. Feed change-over—as required from part to part—is practically instantaneous.

As a result, it is now possible for manufacturers with requirements for a number of different medium size parts to automate production even when runs are not long. These presses bridge the gap between progressive die production and the conventionally large transfer presses. It is possible to have as many as sixteen die stations on a single press of this type.

A press like the one above can provide your plant with press automation *plus flexibility* of production at a cost that heretofore would have been considered impossible. We have a great deal of information on Transflex available. It's yours for the asking.

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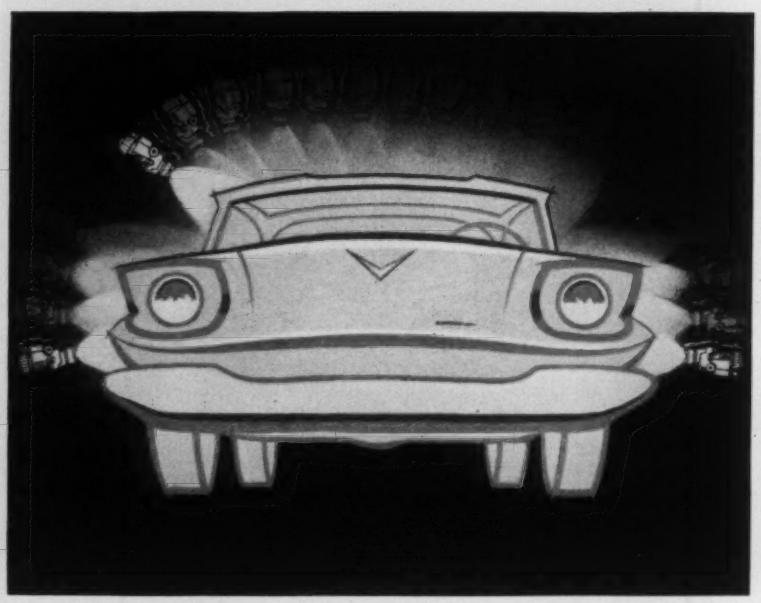
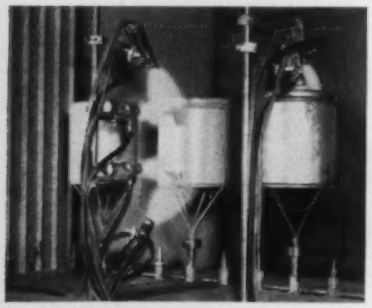


DeVilbiss Automatic Contour Spray Machines are a vital part of the finishing lines in the world's most modern plants, turning out gleaming finishes in a variety of colors at low cost.

DeVilbiss automatic spray machines consistently turn out paint jobs to perfection . . . on products of practically any size and shape. Split-second timing and accurate gun positioning cuts paint waste to a minimum, and ensures absolute uniformity of finish on every part. And these results are attained with high-volume production at remarkably low cost!

But it takes more than just ordinary spray equipment to do the flawless, cost-saving jobs that are demanded today. DeVilbiss meets this demand with experience and know-how that combine the full knowledge of materials, production methods, and spray techniques with the most versatile, efficient automatic spray equipment that's available.

Why not let us test run your product in our Customer Lab – without obligation – for a report of actual costs, plus projected savings over your present system? Our nearby representative will gladly make the arrangements.



Simultaneous painting of exterior and interior of these 5-gal. pails is typical of versatility, efficiency of DeVilbiss automatics.

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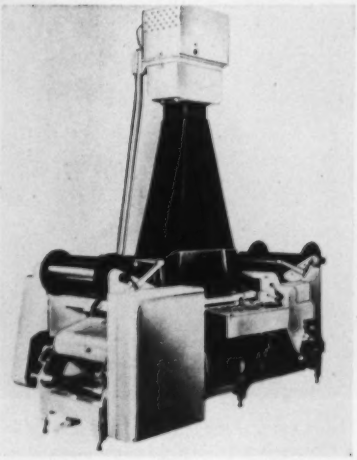
ically for changing conditions as the ship operates in open water or thick ice. The units permit maximum horsepower to be developed without overloading the engines. Characteristics of magnetic amplifier regulators permit the use of small diameter control wiring which facilitates remote location of control stations. This is important on ships operating in ice-filled waters since control is often accomplished from a remote station located on the forward mast of the ship.



IMPROVED photographs from negatives normally considered unprintable can be obtained with electronic photo printer developed by Norden-Ketay Corp. The printer utilizes a brilliant spot of light which scans the negative being printed. Variations of density in the negative are sensed and evaluated through circuits which control the intensity of the spot to the best value for printing a given negative and paper combination. With this equipment, film also can be processed at high speed in roll form.

Automatic Diesel Units Standby At Radar Sites

COMPLETELY automatic diesel power plant has been developed by Consolidated Diesel Electric Corp. The power units are used at gap-filler radar stations, which are designed to operate normally from commercial power supplies. Diesel power plants will stand in reserve or be used as a source of auxiliary power in regular operation.

In the event the normal power supply from commercial lines fails, weakens, fluctuates, or otherwise ceases to provide steady and suf-

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426	456	486	516	546	576	606	636	666
427	457	487	517	547	577	607	637	667
428	458	488	518	548	578	608	638	668
429	459	489	519	549	579	609	639	669
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ficient power for radar operation, the automatic diesel power plant turns itself on and provides power to the full load in less than 12 seconds. The unit contains provisions for disconnecting the load from the commercial power supply before taking over, and for making an automatic 2-hour check of the commercial power supply voltage to see if conditions are suitable for the radar equipment to be returned to normal operation.

Each radar site will include two such standby diesel units. Both units are set into operation simultaneously when commercial power fails. The first unit to reach full power output sends a signal to the second unit which then turns itself off and returns to a standby condition to be ready to take over in case of failure of equipment. If one of the diesel generator sets ceases to operate at full capacity or fails because of insufficient lubricating oil or any other malfunction, the second unit automatically turns itself on and assumes the load. At the same time the inoperative unit returns itself to the standby condition, turns itself off and relays back to a main control center that it has failed and the reason for the failure. Technicians at the control point then know what repairs are necessary and what replacement parts are probably needed. Such a system enables the Air Force to maintain the radar line with a minimum of trained technicians.

MEETINGS AND EVENTS

Mar. 11-15—

International Atomic Exposition. With Nuclear Engineering and Science Congress to be held Convention Hall, Philadelphia. Additional information may be obtained from American Institute of Chemical Engineers, 25 W. 45th St., New York 36, N.Y.

Mar. 18-21—

The Society of the Plastics Industry Inc. National conference and Pacific Coast Exposition to be held Shrine Exposition Hall, Los Angeles. Additional information may be obtained from society headquarters, 250 Park Ave., New York 17, N.Y.

Mar. 18-21—

Institute of Radio Engineers. National Convention and exposition to be held Hotel Waldorf-Astoria and N.Y. Coliseum, New York City. Additional information may be obtained from society headquarters, One E. 79th St., New York, N.Y.

Mar. 18-21—

Military Automation Exposition. To be held Trade Show Bldg., New York City. Additional information may be obtained from Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, Pa.

Mar. 25-29—

Western Metal Show. To be held Pan-Pacific Auditorium, Los Angeles. Additional information may be obtained from American Society for Metals, 7301 Euclid Ave., Cleveland 3, O.

Mar. 26-27—

Conference on Instrumentation for Iron and Steel Industry. Seventh annual meeting to be held Hotel Roosevelt, Pittsburgh. Additional information may be obtained from F. D. Marton, 845 Ridge Ave., Pittsburgh 12, Pa.

Apr. 8-10—

American Society of Mechanical Engineers. Spring meeting to be held Dinkler-Tutwiler, Birmingham, Ala. Additional information may be obtained from society headquarters, 29 W. 39th St., New York 18, N.Y.

Apr. 9-10—

Automatic Control for Process Industries. Symposium of the Engineering Institute of the University Extension Div., University of Wisconsin to be held Madison, Wis. Additional information may be obtained from Engineering Institute, University Extension Div., University of Wisconsin, Madison 6, Wis.

Apr. 9-11—

American Welding Society. National spring meeting and exposition with technical sessions cosponsored with AIEE to be held

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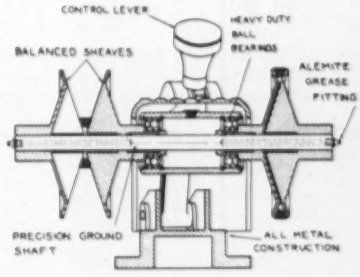
- Infinitely variable over wide speed ratio up to 10:1.
- Changes speed quickly while machine is running.
- Compact—all metal—balanced sheaves—large ball bearings.
- Minimum wearing parts—no expensive replacements.
- Lubrication needed at only three points.



This cut-away sketch shows the practicality and simplicity of the Select-O-Speed's design. Nothing complicated, just two variable pitch sheaves mounted on a pivoted shaft. No internal mechanism—no intricate parts. Shifting the control lever causes a momentary variation in tension between the driving and driven belts which changes the sheave pitch diameters and the driven speed.

Get the facts about the Select-O-Speed. Tell us about your application. We'll give you our recommendations. Request Bulletin 118.

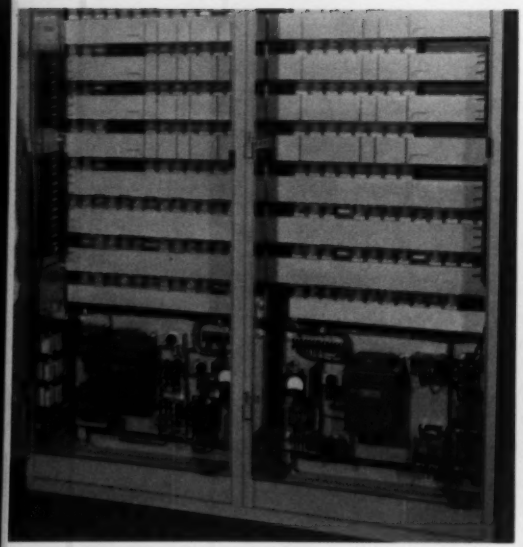
LOVEJOY FLEXIBLE COUPLING CO.
2806 W. Lake St., Chicago 44, Illinois

Circle 563 on Inquiry Card

Next Page Circle 564→

VOLTAGE STABILIZING TRANSFORMERS

Here's how G-E voltage you increase production



On this newly developed General Electric static switching system control panel, General Electric voltage stabilizing transformers are used to help prevent malfunctions due to large voltage variations.

In Ford Motor Company's new Mahwah, New Jersey assembly plant, G-E voltage stabilizing transformers are used to stabilize control current on the more than 11 miles of assembly lines. More than 60 G-E voltage stabilizing transformers installed primarily on control centers at the Mahwah Plant hold relays in during line surges caused by electrical storms.

stabilizing transformers can help in your manufacturing processes

If your manufacturing processes require control of speed, color, position, thickness or uniformity—you need General Electric voltage stabilizing transformers. Your ability to compete in the marketplace depends upon your meeting the increasing demands of appearance, design, uniformity and quality, and at the same time, increasing production without increasing costs or losses due to poor quality control or test standards.

If your process utilizes beta-ray thickness gages, electronic counters, X-ray inspection or other electronic measuring instruments, the results will only be as effective as the stability of the input voltage. Incorrect voltage means erratic speed control. Result: poor quality, rejects.

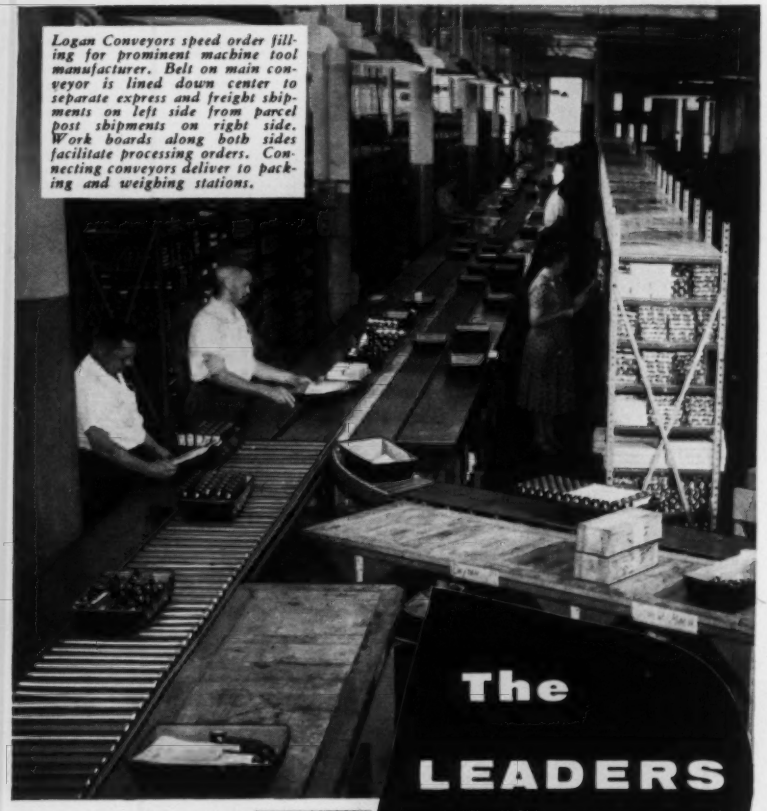
In all process industries, such as textiles, wallpaper, aluminum foil, floor covering, printing—precise voltage is a key to increased production.

General Electric voltage stabilizing transformers are extremely sensitive and have a high speed response. In addition, they are completely automatic, lightweight, inexpensive and rugged.

Another benefit you get with G-E voltage stabilizing transformers is *continuous* production. Due to the sensitivity and high speed response, voltage will remain at a level high enough to keep control relays locked in even when line voltage is reduced by as much as 75% of rated line voltage—your production line will continue to operate.

For further information, and to learn how General Electric voltage stabilizing transformers can increase *your* production, contact your nearest G-E Apparatus Sales Office, or write for bulletin GEA-5754 to Section 410-49, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

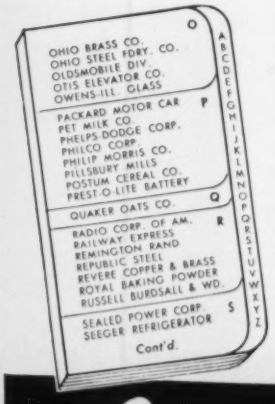


Logan Conveyors speed order filling for prominent machine tool manufacturer. Belt on main conveyor is lined down center to separate express and freight shipments on left side from parcel post shipments on right side. Work boards along both sides facilitate processing orders. Connecting conveyors deliver to packing and weighing stations.

The LEADERS use Logan

"If you can't lick 'em, jine 'em." Maybe that tough-to-beat competitor is using Logan material handling equipment! If you are not already a Logan Conveyor user, this is a cordial invitation to join the list of industrial leaders who employ this efficient aid to: Step up production tempo, increase capacity, speed deliveries, save manpower, decrease labor turnover. Write for further information or for nearest engineer to call.

LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.



Logan Conveyors

Hotel Sheraton and Convention Hall, Philadelphia. Additional information may be obtained from R. T. Kenworthy, 12 E. 41st St., New York 17, N.Y.

Apr. 15-17—

Symposium on Systems for Information Retrieval. Demonstrations of working systems and symposuim on problems and techniques—cosponsored by School of Library Science of Western Reserve University and the Council on Documentation Research, to be held on the Western Reserve campus, Cleveland. Additional information may be obtained from J. H. Shera, School of Library Science, Western Reserve University, Cleveland 6, O.

Apr. 25-26—

Twelfth Annual Management Engineering Conference. Cosponsored by the Society for Advancement of Management and the Management Div. of ASME to be held Hotel Statler, New York City. Additional information may be obtained from Society for Advancement of Management, 74 Fifth Ave., New York 11, N.Y.

Apr. 29-May 3—

Materials Handling Exposition. American Material Handling Society will hold conference in conjunction with show having theme "Materials Handling, Key To Automation." To be held Conventional Hall, Philadelphia. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N.Y.

"We specialize in small-scale automation."

EARLY TELETYPEWRITER

TELETYPE MODEL 28 PRINTER

50 YEARS THAT CHANGED THE PICTURE

The need for a reliable printing telegraph instrument that would provide a typed record of the message for both sender and receiver brought the company now known as the Teletype Corporation into the picture in 1907. From the halting performance of the original page printer to the smooth 100 words per minute of today's precision equipment has been a major step in communications.

But today Teletype equipment is often far more than a communication instrument. It is a basic element in production control systems . . . its ability to transmit and reproduce text and punched tape is harnessed to office automation . . . it provides a "conveyor system" for channeling complex raw data to a computing center thousands of miles away—and getting the answers back in a twinkling.

Indeed, Teletype machines have made many of the dreams of 1907 a daily part of today's business world. And the horizons widen daily as new dreams occupy our engineers and keep our laboratories humming.

If you would like a copy of our booklet, "The ABC's of Teletype Equipment," write to Teletype Corporation, Dept. AU3, 4100 Fullerton Ave., Chicago 39, Illinois.

TELETYPE®

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1957 Golden Anniversary Year

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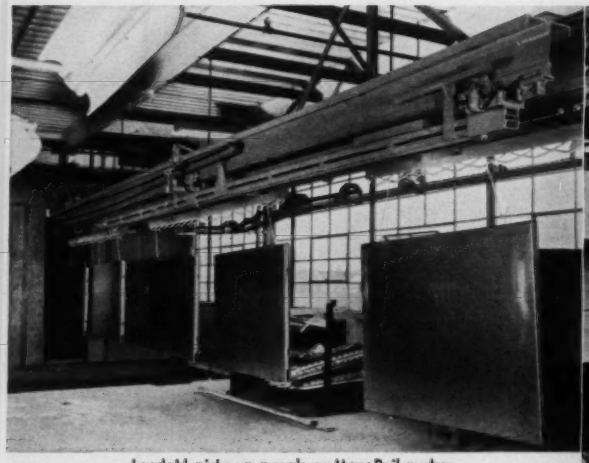
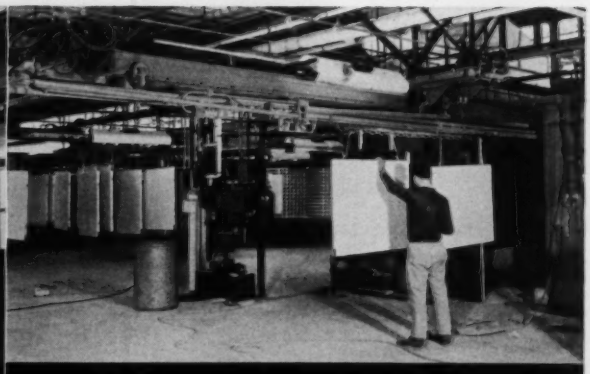
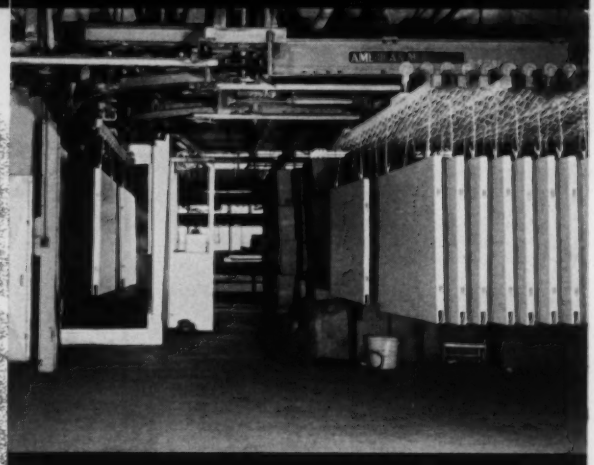


Landahl picks up panels as MonoRail pushes them from degreasing.



MonoRail pneumatically pushes a "car" of panels into a finish spray booth.

Automatic Finishing with Power LANDAHL and AMERICAN MONORAIL



Finished panels are pushed by MonoRail from the bake oven.

Space was saved and automatic finishing achieved by combining two overhead handling systems.

American MonoRail cars carrying metal panels move through degreasing, priming, finishing and baking. In each operation either loading or unloading is performed automatically by power — the Landahl Chainless Conveyor acting as a "pusher" over most of the system.

Here is "team work" engineering to take advantage of the flexibility of both American MonoRail and Landahl Chainless Conveyors.

This efficient system is installed at Fostoria, Mfg. Co., Fostoria, Ohio, for finishing metal panels for office partitions.

For details on how American MonoRail or Landahl Conveyors can cut your handling costs, write today.

Member of The Materials Handling Institute, Inc. & MonoRail Manufacturers' Association.

For Power Driven Conveyors, Use Landahl Chainless Conveyors

AMERICAN MONORAIL COMPANY

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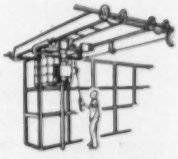
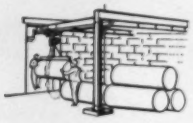
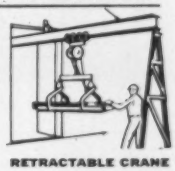
AUTOMATIC DISPATCH



STACKER CRANE

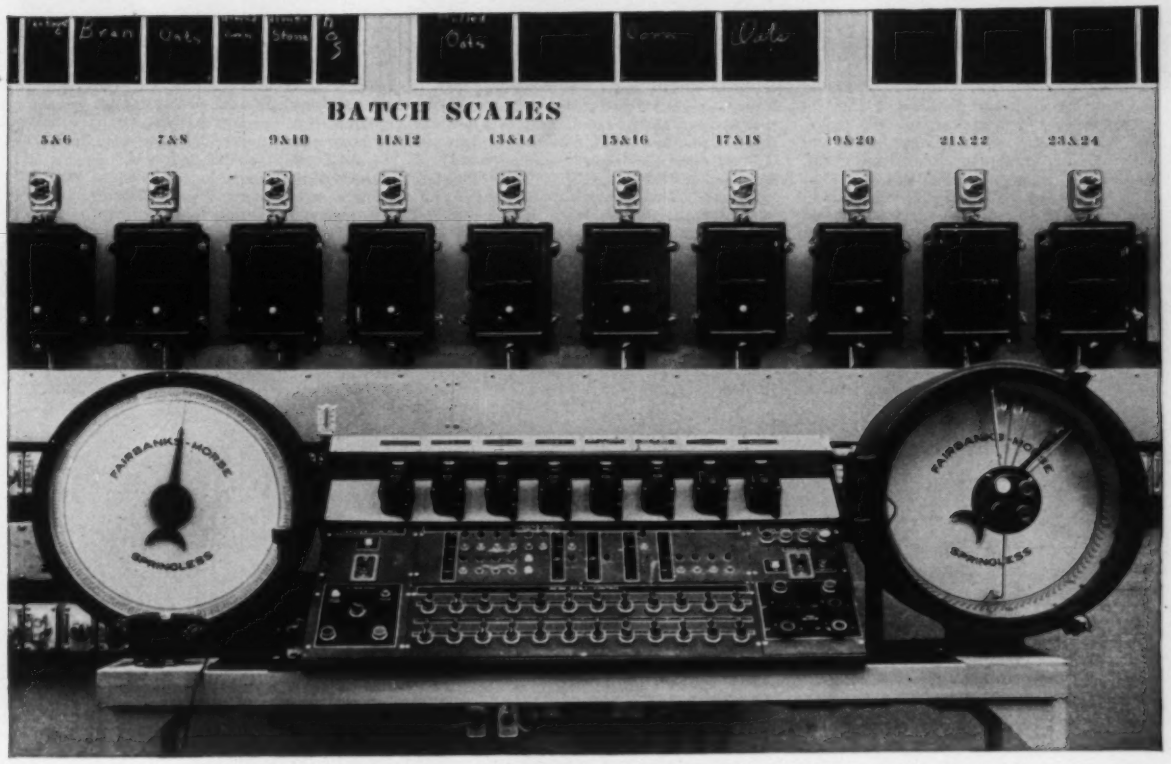


MANUAL MONORAIL



RETRACTABLE CRANE

Twenty-six in one



There are 26 separate scales answering to the switches on the control unit of this Fairbanks-Morse electromechanical batcher installed at the Farmers' Elevator Service Company of Fort Dodge, Iowa, by contractor Hogenson Construction Company of Minneapolis.

Twenty-four of the Fairbanks-Morse hopper scales deliver preestablished quantities from their respective bins according to standard formulas set up on their individual beam indicators. The right dial controls the weighing of expensive additives — molasses, for instance. Presetting is done right on the dial, and can be varied from batch to batch. The left dial is a remote indicator used to check the final weight of the complete batch before it is dumped into the mixer.

Fairbanks-Morse builds mechanical and electronic batchers as well as this electromechanical batcher designed for the specific conditions at Farmers' Elevator Service. Whatever your batching requirements, Fairbanks-Morse will design and build to give you the traditionally accurate Fairbanks-Morse performance with a new measure of speed, economy—and profit.

Fairbanks, Morse & Co., Dept. A-3, 600 South Michigan Ave., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

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Where do you belong in

Computer Circuit Design Engineers plan electronic circuitry for advanced airborne analog and digital computers . . . design linear and pulse circuits employing transistors, tubes, magnetic devices. Opportunities also exist in airborne power supply design, or to develop new techniques for marginally checking computer performance. *Do you belong on this team?*

Computer Logical Design Engineers determine the systems outline of a computer and its inter-connection with external equipment. Close liaison is maintained with mathematical support, circuit design, packaging and test engineers. Computer speed, memory size, configuration and arithmetic structure are tailored to requirements of weapons systems. *Do you belong on this team?*

Systems Evaluation Engineers test and evaluate electronic analog and transistorized digital computer systems design for aircraft; evaluate new systems and improvements to insure compliance with specifications and Air Force requirements. Other assignments: tie-in testing of peripheral equipment, liaison with design, development and field engineering. *Do you belong on this team?*

Harry Branning (center): B.S.E.E. 1950, Syracuse. Design Engineer in circuit design, 1951; October, 1954, promoted to Associate Engineer; April, 1956, promoted to Staff Engineer, Systems Planning. In June, 1956, appointed Project Engineer and Manager of the 110 Computer Circuit Design Department; discussing the performance and packaging details of a transistorized read amplifier.

William Dunn (standing): M.E. 1950, M.S.E.E. 1952, Stevens Institute. Technical Engineer, 1955; April, 1956, promoted to Associate Engineer; August, 1956, transferred to Development Engineering in charge of Logical Design for digital computers in advanced weapons systems; here discussing Boolean Algebra method of optimizing the logical design of an airborne digital computer.

Eli Wood (left): B.S.E.E. 1950, Connecticut. IBM Customer Engineer, July, 1950; September, 1952, transferred to ACL Field Engineering. February, 1954, in charge of Field Engineering at Hunter AFB; May, 1955, Associate Engineer; appointed Project Engineer, Manager of Systems Evaluation in August, 1956; here investigating a problem in radar data presentation set evaluation testing.

The brief records of the men cited above indicate only a few of the exciting activities right now in IBM Military Products. This division, organized 18 months ago, has grown enormously. A small-company atmosphere prevails. Men work in small teams . . . individual contributions are instantly recognized. Promotions occur frequently.

As a member of IBM Military Products, you'll enjoy physical surroundings and equipment second to none. Educational programs at IBM expense lead to advanced degrees. Salaries and benefits are excellent. Stability is guaranteed by IBM's history of consistent achievement—underlined by the fact that the rate of turnover at IBM is only one-sixth the national average.

Throughout the length and breadth of the United States IBM has built modern plants and laboratories. This map points out the various locations where you might live as an IBM em-

DATA PROCESSING
ELECTRIC TYPEWRITERS
TIME EQUIPMENT
MILITARY PRODUCTS

IBM MILITARY PRODUCTS

IBM Military Products?

Systems Engineers oversee the engineering support provided by the Systems Coordination and Specification Group to the factory on the AN/ASB-4 Bombing-Navigational System. Air Force requirements are analyzed and the resulting engineering changes evaluated to determine effect on system performance and accuracy. Mathematical error analyses are run. *Do you belong on this team?*

Systems Analysts anticipate performance and recommend design criteria before and during development of equipment. Later, they compare dynamic performance accuracy and reliability characteristics with what has been anticipated. Other assignments include Digital Computer Systems Engineering, Input-Output and Analog-Digital Conversion Engineering. *Do you belong on this team?*

Quentin Marble (left): B.S.M.E. 1951, Syracuse. Joined IBM in 1951; promoted to Design Engineer in 1952; May, 1955, promoted to Associate Engineer, and then to Project Engineer, Manager of the Systems Coordination and Specification Group, Production Engineering Department, in February, 1956; shown here describing a unique cooling design to a new employee in his group.

Monroe Dickinson (left): B.S.E.E. 1952, W.P.I.; M.S.E.E. 1954, M.I.T. Technical Engineer in analog and alternate computer techniques for weapons systems, 1952; Associate Engineer responsible for systems design and analysis, 1954; December, 1955, Staff Engineer, responsible for research planning; here reviewing set-up on laboratory analog computer of a sampled data control problem.

Exceptional career opportunities are now open in IBM Military Products for E.E.'s, M.E.'s, physicists, and mathematicians, in the following fields:

SYSTEMS PLANNING AND ANALYSIS
DIGITAL AND ANALOG SYSTEMS
INERTIAL GUIDANCE
SERVO-MECHANISMS
ELECTRONICS
MECHANICAL DESIGN
ELECTRONIC PACKAGING
PROGRAMMING
FIELD ENGINEERING
RELIABILITY
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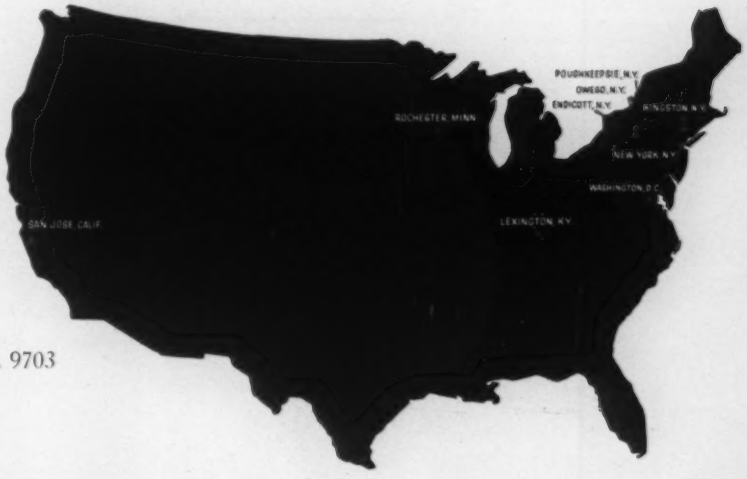
Be sure to visit the IBM booth at the I.R.E. show, March 18 through 21.

ployee. IBM Military Products include the Airborne Computer Laboratories located in Owego, N. Y., and the Project SAGE installations directed from Kingston, New York.

Here is a real ground-floor opportunity that you can't afford to overlook. Without exaggeration, your potential in this dynamic young field of electronic computers is virtually unlimited. Get all the facts. Write, outlining your background and interests to:

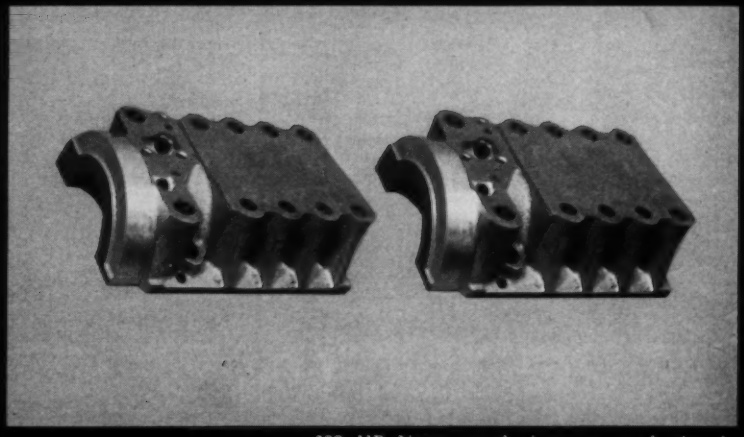
R. A. Whitehorne
Manager of Engineering Recruitment, Dept. 9703
International Business Machines Corp.
590 Madison Ave., New York 22, N. Y.



Circle 569 on Inquiry Card

THREE NEW DEVELOPMENTS
Increase Production

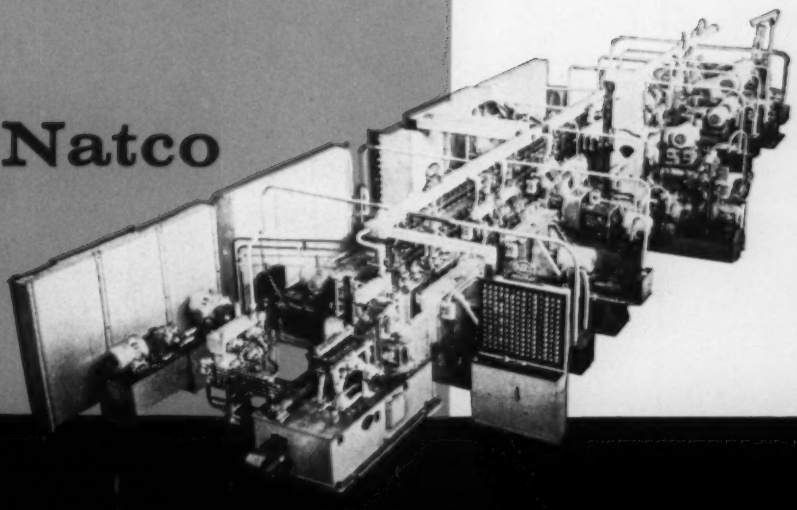
2-at-a-time processing



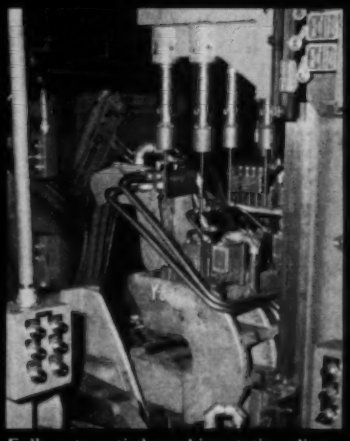
300 HP Natco greatly increases production by processing two complete sets of bearing caps at once.

Bearing caps—240 *sets* per hour—six times the production rate of the machine replaced! This new Natco processes two complete sets at once. It loads surface-broached castings automatically, performs 80 machining operations, places matched sets of finished bearing caps on the assembly conveyor. In addition to broaching and sawing, this 300 HP, 27-station Natco, drills, reams taps, turns, mills, probes and faces.

help this Natco 600%

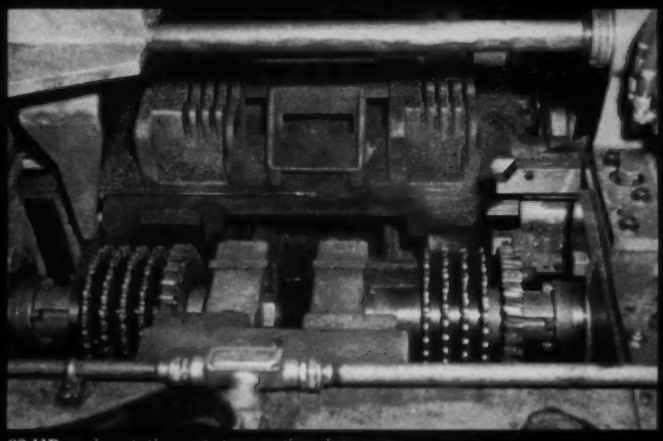


Unique Broaching Station



Fully automatic broaching station eliminates need for withdrawing broaching tools after cut. Broaching tools are pulled completely through hole, removing .030″ stock.

New Rigid Saw Station



80 HP sawing station cuts two castings into complete sets of 5 caps each. All surfaces parallel within .0015″. Fixture feeds castings into stationary mounted saws, providing rigidity for accurate 14 ipm cutting.

Whatever your high production problem, our engineers will work closely with your people to develop exactly the method and the machine to do your job best. Besides special way-type, index and transfer machines, Natco also builds multiple drilling, boring, facing and tapping machines. Call your nearest Natco office in Chicago, Detroit, Buffalo, New York, Boston, Philadelphia, Cleveland and Los Angeles. Distributors in other cities.

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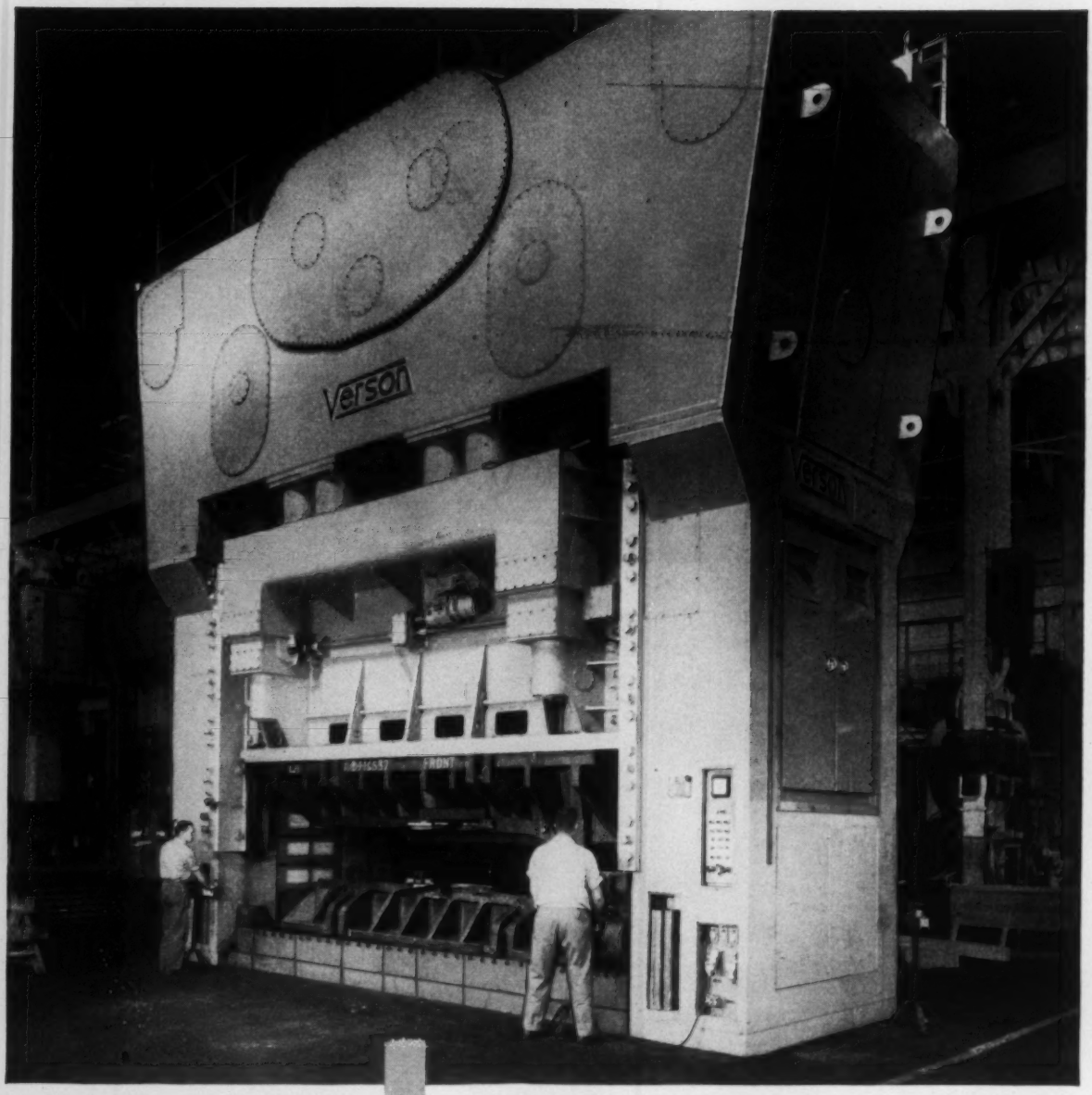
Partners in Production

NATCO

NATIONAL AUTOMATIC TOOL COMPANY, INC. *Richmond, Ind.*

Ask for information about the PAYD (Pay-As-You-Depreciate) Finance Plan



WORLD'S LARGEST Mechanical Double Action Press by

TRADE Verson MARK

The huge press illustrated above marks a milestone in press development . . . the largest mechanical double action press in the world.

Vital Statistics—Rated capacity is 2500 tons. Weight is in excess of 1,000,000 pounds. Height is in excess of 38 feet. Bed and ram measure 90″ (F-B) x 208″ (R-L). The press operates at seven strokes per minute.

Just another big press? No, but this unique press *is* just another example of Verson's advanced concepts of press design and engineering. Whatever your press requirements, these concepts assure you of more press for your money... more profitable production in your plant. For specific recommendations, send an outline of your requirements.

VERSON ALLSTEEL PRESS CO.

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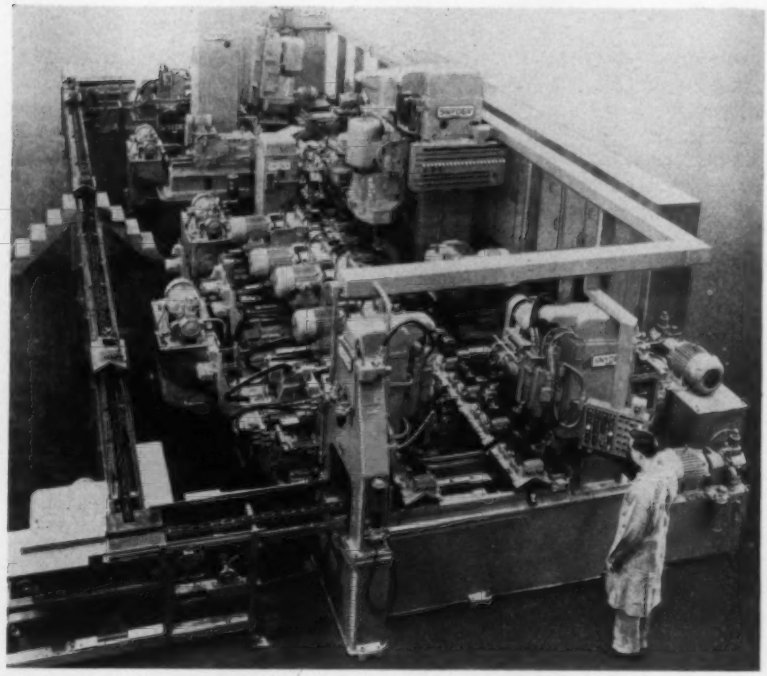
MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TOOLING •

CUSHIONS • VERSON-WHEELON DIRECT ACTING HYDRAULIC PRESSES

Circle 571 on Inquiry Card

By JAMES C. KEEBLER
Associate Editor



Two forged steel steering knuckles are fixtured in each pallet on this Snyder transfer machine. Moving parts on fixtures are lubricated by a circuit that is built onto each pallet and is periodically connected to hand pump hose shown on machine column in foreground. All spindles and slides are oiled by automatically pumped and metered lubricant which is supplied through Trabon distribution equipment that services 60-foot long machine.

Lubricated Longevity

AUTOMATION thinking enters and alters each phase of the automaker's work. He designs a product that's loaded with automatic features. He learns how to fashion these designs so that the parts can be made automatically. He devises equipment and processes that perform automatically. He outfits this equipment with services that will make it automatically last longer.

A Drop In Time . . .

A stitch in time saves nine. This idea is the backbone of the preventive maintenance program and the oil can is a vertebra. If you don't take care of your equipment it won't take care of you.

In any auto manufacturer's machine shop that got big enough to earn the title, there was a crew of full-time oilers. Experience with downtime on equipment gave testimony of the need for a drop in time to keep the mechanisms of production going full tilt.

To managers long experienced with the techniques of having to spend a buck to get a couple bucks, there was no hesitancy about spending lubrication dollars to save downtime dollars and to protect the money already spent in capital equipment.

Like the night watchman on his beat the oiler pounded the pavement to cover his appointed rounds and serve as the guardian of this valuable property. The saying that "It's the squeaking wheel that gets the oil" joined the archieves with "Get out and get under."

Well Overdone

Often the performance of these zealous canhandlers merited a "well done" award. Sometimes the job was well overdone. Oil where you don't want it picks up dirt and this terrible twosome is not only a fire hazard but can breed downtime too.

This is not the only fly in the ointment in the hand can system. Training the talent on the team to know the which, what kind, when and how much of the lubrication requirements of 500,000 square feet of screeching factory space is no small task.

Even after he's got the know-how the man is an insurance risk for he's got to climb ladders to the tops of machine columns; is tempted to invade the privacy of mechanisms in motion, risking being snatched in; and generally resembles an accident looking for a place to happen.

On the other end of the stick there's the sorehead that lost interest in this fascinating work and just makes the rounds. It's pretty hard to tell by looking at a machine how faithful its oiler servant has been.

Sold But Not Forgotten

Complex indeed are the interlocked systems of a highly automated production line. How long will it keep running? This question is not only of concern to the owner and operator. The man who made the sale is equally concerned for the performance of this equipment might well determine the identity of the seller of the next $500,000 machine to keep it company.

How much of the machine builder's fate and fortunes lie in the bottom of someone else's oil can? Awareness of this predicament is expressed in the reams of maintenance manuals provided in the hope that the customer will use all of the aids provided him for the care and feeding of his flock. The

more complex the machinery the greater is the need.

Automakers Aware

Ford's Del Harder told the machine tool builders of the changing nature of shop maintenance that has been nurtured by the use of automated equipment. No longer does he consider the maintenance department as a central location for all maintenance work. "Instead of maintaining machines they are now required to maintain production. The difference is slight but fundamental. Teams of preventive maintenance men must be set up to cover only a specific production area."

These men are charged with a patrol function that not only gives quick follow-up on breakdowns, but also anticipates repairs. To shutdown the machines for purposes of oiling the required lubrication points is time these maintenance men can ill afford to spend and time the production department cannot afford to give. Farval reports reveal it would take an oiler 18 minutes each cycle if he had to hand lubricate the required places on a particular Moline cylinder block boring machine.

Lubrication requirements are not restricted to machine tools. Conveyors, handling devices and all of the moving equipment in the shop is subject to time consuming routine lubrication needs.

Face the Inevitable

One might say that the application of automatic lubrication systems to automatic cycling machines is as logical as the development of automatic defrosting systems for automatic refrigerators. To uphold the dignity of the automatic cycling clan, a machine should not be permitted to automatically dissipate its usefulness as it automatically performs its function.

Like so many other leaves on the automation tree, however, it would be erroneous to give the impression that the first industrial automatic lubrication system was recently devised to satisfy the hunger of today's big automation market. Centralized lubrication was a going thing in the twenties. Today's emphasis serves to highlight the design trend of modern production machinery that is designed to run without breakdown.

A Lincoln pushbutton power lubricating system that greases all the chassis bearings on a 1957 model Lincoln car may be still considered a luxury by the buying public, but their centralized automatic lubrication system on machines in the Lincoln Div. shops is certainly considered more necessity than luxury.

What's Doing

The transfer machine illustrated on the previous page shows the extent to which these systems are applied. All slides, ways, spindles, conveyor-drive pillow blocks and moving parts of any significance are automatically lubricated. Centralized lubrication is even installed on each of the pallets which carry parts through the machine.

Distributor valve blocks mounted in sandwich fashion on each pallet serve all moving parts with lubricant so that the equallizing and clamping mechanisms can be relied upon to function properly. Since the pallets make a complete circuit around the machine these distributors are connected to a pump source only periodically, but this scheduled hand connection to the hose permits one-action hand pumping to serve all points on a given pallet.

Distribution Systems

Automatic systems offered by various manufacturers differ in detail but the general layout is to pump from a central source into main distribution lines and from there into branch distribution lines. With systems that use metering valves at the distribution blocks, spool type valves and pistons measure the quantities dispensed to each outlet point.

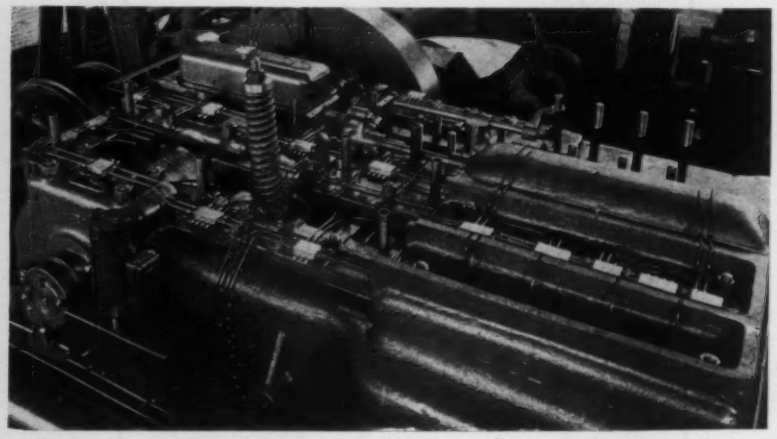
Outlets may lead to a journal, a wick sump, a spray nozzle or other method of applying the lubricant. Farval's spray valve system delivers the lubricant from the measuring valve to a nozzle where the air control valve is actuated by the metered quantity of lubricant.

Spray systems use new diluent lubricants that depend on evaporation of their thinning agents to produce the resilient film required to carry gear loads and protect gear surfaces.

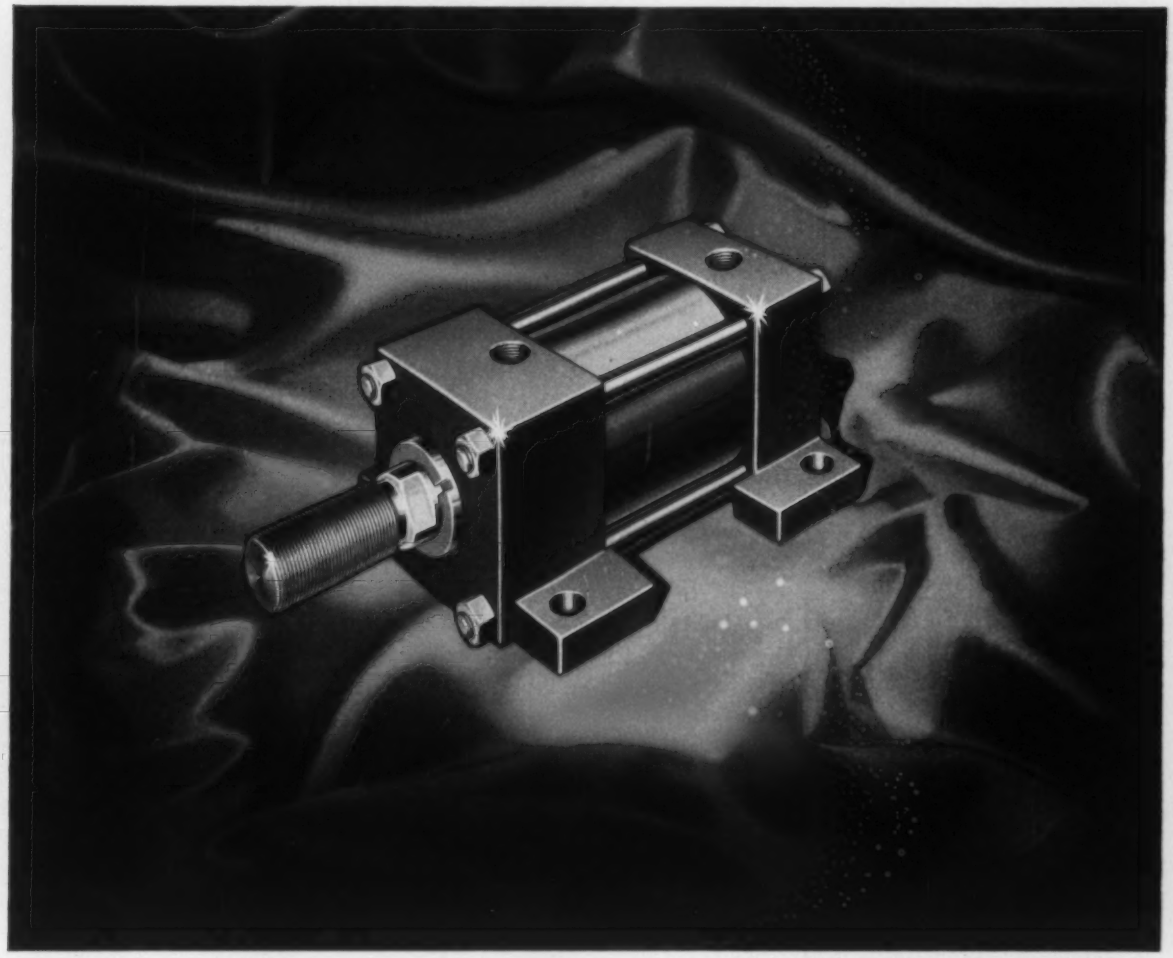
Distribution circuits that feed distribution circuits are particularly well adapted to the building-block approach to machine design that is in favor with automakers who look upon this as an answer to their need for flexible equipment arrangements that can withstand the impact of model changes.

Another Helping Hand

Manufacturing engineers who are seeking assistance with their automatic lubrication requirements are finding know-how available from manufacturers of such equipment and also from the major oil companies whose industrial engineering departments are experienced in helping customers put the right oil in the right place and thereby gaining customers.



Standard Farval automatic pumping unit installation on forging machine to serve 59 points of lubrication with oil.



Illustrated—Logan Super-Matic Cylinder Meets J.I.C. Standards

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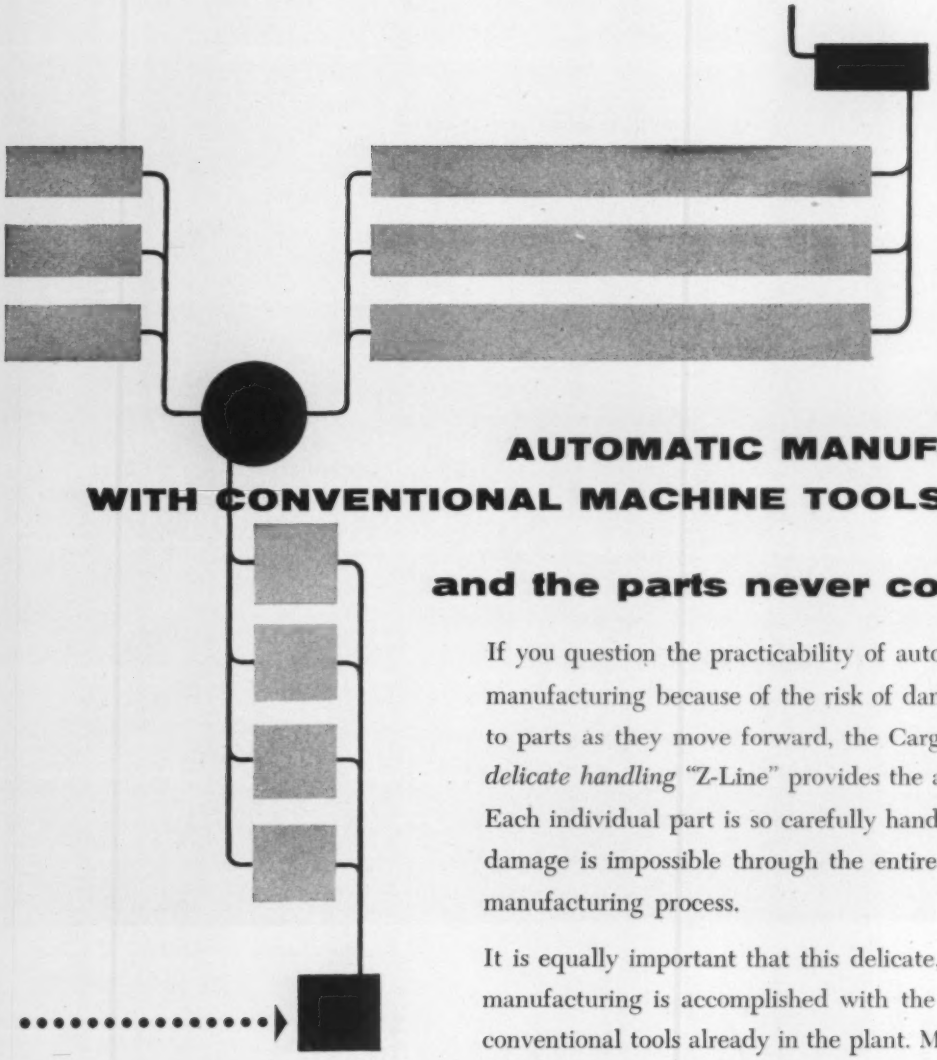

AUTOMATIC MANUFACTURING WITH CONVENTIONAL MACHINE TOOLS . . .

and the parts never collide

If you question the practicability of automatic manufacturing because of the risk of damage to parts as they move forward, the Cargill-Detroit *delicate handling* "Z-Line" provides the answer. Each individual part is so carefully handled that damage is impossible through the entire manufacturing process.

It is equally important that this delicate, automatic manufacturing is accomplished with the conventional tools already in the plant. More than 70% of the total cost of these lines *is represented by those machines.*

We will appreciate an opportunity to tell you about these installations.

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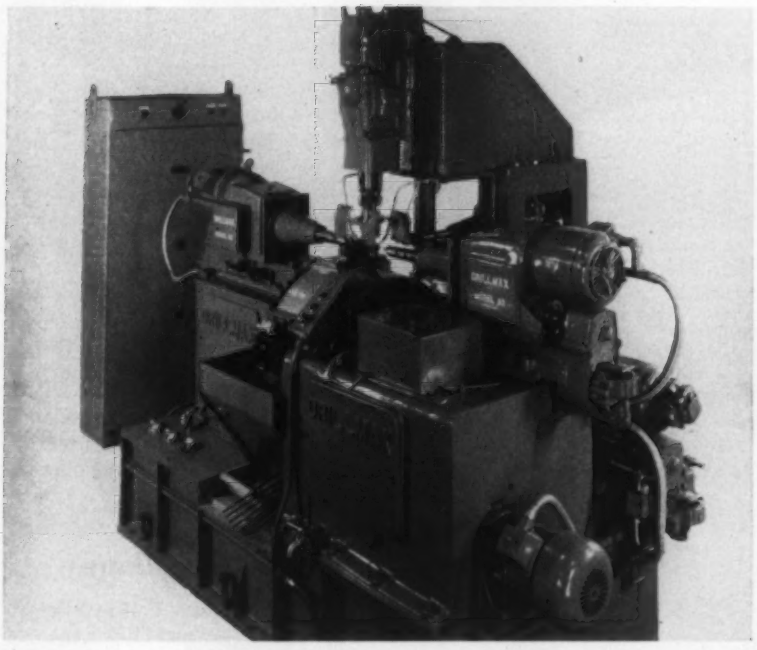
Designers and Builders of Automatic Manufacturing

2254 Cole Avenue Birmingham, Michigan

Established in 1949

notes from britain

By FRANK G. WOOLLARD
British Correspondent



Four-station drum indexing machine developed by Peter Brasshouse Ltd. is capable of machining gas-governor bodies in a cycle time of 8 seconds. This equipment is an example of automatic machine tools being built by several companies normally considered suppliers of fixtures, jigs and tools.

Demand Creates Suppliers

EXCEPT in the leading automobile concerns, automation in Britain cannot be described as a wholesale development. Rather it is a cautious replacement of existing machinery by that of more advanced types. The trend is toward the adoption of less complex machines and apparatus. This leads either to standard machines coupled by linking devices or to special machines built up from standard unit heads; with the rotary, dial indexing machines next in favor and the in-line transfer machines a long way behind.

It is difficult to discern an absolute pattern in either demand or supply of automatic plant; but it is significant that the builders of standard machines, with few exceptions, prefer to continue with standard types. This is, of course, understandable since the pressure of demand for standard machine tools remains high — both at home and abroad. This has, however, had the effect of bringing the makers of fixtures, jigs and tools into the picture as builders of automatic plant. There are three notable examples of this trend: C.V.A. Jigs, Moulds & Tools Ltd., Peter Brasshouse Ltd., and the Brooke Tool Mfg. Co. Ltd. Other smaller concerns are also entering this field.

C.V.A. are now builders of specialized machines on a large scale and they are, inter alia, producing milling machines of the automatic type under license from Kearney and Trecker; for this activity they have built a fine new Works.

Brooke Tool dispose of their unit heads to A.M.T. (Birmingham) Ltd., who mount the heads on appropriate bases as individual or rotary type machines. They also have in mind the building of in-line transfer machines when called for. In Britain, excepting the leading automobile manufacturers, the in-line machine is not favored to any great extent.

Brooke Tool make five sizes of unit heads ranging from 1 to 20 hp at 1500 rpm. The smaller units have the drive motors, flange mounted, on the moving head casing. The motor drives through an interchangeable set of gears and alternative speeds are obtained by pick-off gears. They can be arranged for right or left hand drive. The feed can also be modified by changing pick-off gears. Rapid traverse is obtained by an independent motor on the slide which moves the head by means of a lead screw; this is fitted with a brake to hold it during cutting operations. A gear pump supplies lubrication for the working parts and the coolant pump motor is provided with a starter so that suds flow only when cutting is in progress. The control panel can be supplied on the head or built into the machine base.

In the case of the 12, 15 and 20 hp units, the drive motor is built into the main casing and the traverse motor is built into the slide. The drive in these larger units is taken by V-belts via worm gears to the main spindle. Speed changes are effected by changing the pulleys. The other details are much the same as for the smaller units. The necessary limit switches

RCA "PREMIUM" TUBES assure *optimum performance* of electronic equipment which must operate under "tough" conditions of vibration, shock, temperature, and humidity. In such equipment their many special qualities of durability minimize early failures, and increase the reliability of operation—*help keep production rolling!*

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RCA "PREMIUM" Type No.*	Prototype No.	RCA "PREMIUM" Type No.*	Prototype No.
0A2-WA	0A2	5726/	
0B2-WA	0B2	6AL5-W/6097	6AL5
2D21-W	2D21	5727/2D21-W	2D21
6AC7-W	6AC7	5749	6BA6
6J4-WA	6J4	5750	6BE6
5636	6AS6	5751	12AX7
5636-A	6AS6	5751-WA	12AX7
5654	6AK5	5814-A	12AU7
5654/6AK5-W	6AK5	5814-WA	12AU7
5654/		5840	.....
6AK5-W/6096	6AK5	5840-A	
5670	2C51	6005	6AQ5
5686	.....	6072	12AY7
5690†		6073	0A2
5691†	6SL7-GT	6074	0B2
5692†	6SN7-GT	6080-WA	6AS7-G
5693†	6SJ7	6101	6J6
5718	.....	6101/6J6-WA	6J6
5718-A	.....	6136	6AU6
5719	.....	6186/6AG5-WA	6AG5
5719-A	.....	6189/	
5725	6AS6	12AU7-WA	12AU7
5726	6AL5	6201	12AT7
5726/6AL5-W	6AL5	6205	5840

NOTE: †"Special-Red" Tubes. *"PREMIUM" versions may differ from their prototypes in mechanical and/or electrical characteristics. Check tube data before replacing a prototype with a "PREMIUM" type.

Circle 574 on Inquiry Card

are built into the main casing and are thus protected from dust and suds. At request, a dead stop for counterboring or spotfacing is available as, also, is an incremental feed mechanism for deep drilling. A universal right angle milling attachment can be added if desired.

These units are remarkably neat in appearance. In the smaller types the operating head resembles a flush sided double cube with the cylindrical shape of the drive motor protruding at one end. In the larger sizes the drive motor is included in the casing and the traverse motor is concealed within the slide. The only projection is the bar on the slide which carries the adjustable stops for the switches.

The A.M.T. company mounts these heads on any required base or column, or on wings — which attached by a saddle to a circular base become units of rotary machines. These rotary machines can have tables ranging from 30 to 48 inches diameter, accommodating up to eight operating stations. The bases are fitted with suds traps and means for collecting chips in a manner convenient for quick removal.

Peter Brasshouse offers six sizes of "Drillmax Screw Feed Unit Heads" for incorporation into single-station, multistation, rotary or transfer machines. The power rating ranges from 1.5 to 20 hp. Fractional hp units are also being made. These are small and compact and can be closely packed together.

The main casing which houses the spindle is mounted on a slide. The feed is taken from the spindle by means of bevel gears which drive through pick-off gears mounted accessibly at the side of the casing. These in turn actuate a worm wheel which is coupled to the feed nut. A separate motor mounted on the slide drives, through a reduction gear, a lead screw for the fast traverse. Trip switches, fitted in the main casing, are operated by dogs attached to a bar mounted on the slide. A dead stop mechanism and a woodpecker action can be fitted. Large multispindle cluster boxes can be accommodated, and controlled tapping can be ensured. All these heads can be adapted for hydraulic operation should this be preferred.

The machine illustrated is a good example of a Brasshouse production. It is a four-station drum indexing machine for the complete machining of gas governor bodies made in light alloy. The machining units are mounted on a fabricated base and consist of the drum unit and four 2-hp and three 1-hp unit heads. The drum is fitted with four air-operated fixtures. The sequence of the four stations is as follows: (1) Load in air operated fixture; (2) drill four holes, tap one hole, and drill and face inlet and outlet holes for tapping; (3) tap six holes; and (4) eject workpiece automatically and wash fixture.

It is by such special machines that the interest in automation is being fostered particularly among the smaller concerns who could not, or would not, contemplate larger or more fully automatic plant until they have tried their "'prentice hands" on these smaller, simpler tools.

Here and There

● The Conservative Political Centre has issued a pamphlet entitled "Automation and the Consumer". It is pointed out that the problems arising from automation are mainly problems of timing—of applying new techniques with the minimum of human dislocation, and of securing enough savings to permit the necessary investment in new capital assets to be made.

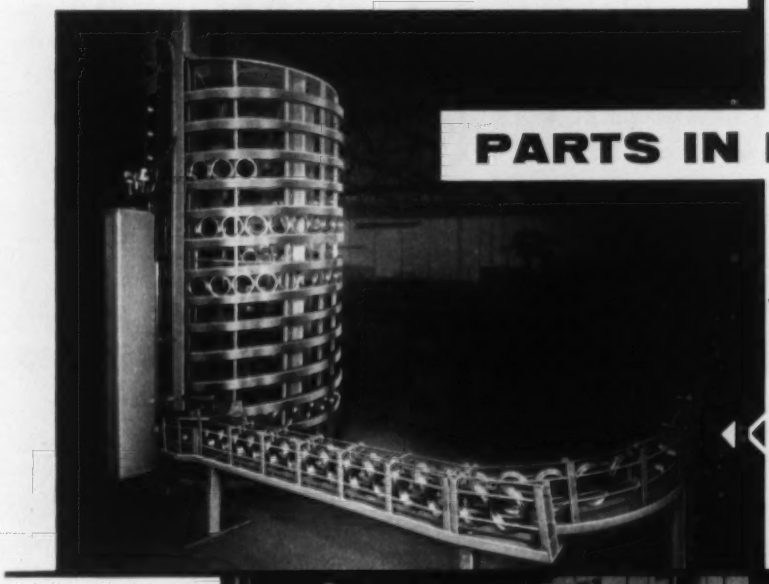
As automation does not in fact present fundamentally new economic problems, new economic policies are not required. But the point is made that several things are required of the government: Its first duty is to insure that changes take place so that there are jobs available; provisions must be made for a wide extension of technical education; and help must be given in special cases by retraining or with other assistance.

The authors of the pamphlet also point to one important fact: It is the consumer at home and in the export markets who should benefit from automation if the standard of living is to rise. Only a relatively few actually work with automation, but all are consumers.

For automating

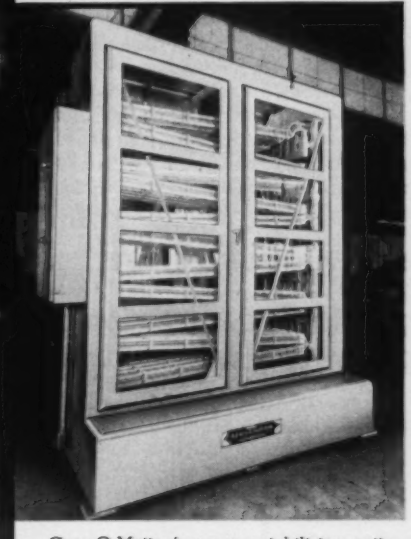
PARTS IN PROCESS...

...with { *demand control*
selective feeding
active storage
positive movement



Gear-O-Mation's rotary storage units for parts that can roll. Pneumatically loaded double threads (retaining tracks) store parts for true "as-required dispensing". Custom built for high capacity (Bulletin GO-567).

Gear-O-Mation's high speed equipment for the automatic "basketing" of parts removes a slow-down point of processing. Assembled from standard components, the units are custom-tailored—this one loads center-bored pinions at 3000 per hour (Bulletin No. GO-568).



Gear-O-Mation's process stabilizing unit—a parts bank to insure production continuity. Recently developed for use between operations, the equipment forms an integrated "demand feeding" system. It will check, store and feed from one to more than 5000 cylindrical parts depending on size (Bulletin No. GO-561).

Imaginatively engineered equipment, functionally designed to extend the scope and application of automated production systems, is now in manufacture at Gear-O-Mation. Not just work-handling or transfer units, but packaged units that offer positive control at any point installed. Gear-O-Mation also manufactures part washers, size classifiers, machine loaders and unloaders, elevators, and other equipment—for semi- or full automatism in large or small plants. Write us for details.

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Progress Report:

SCHRADER AIR PRODUCTS CAN MAKE PRECISION OPERATIONS EFFICIENT

● Let's clear the air about close tolerances

We've faced it. Lots of manufacturers still think air is as unpredictable as the weather report. But others know better, because they've taken the time to let a little sunlight on the subject. These open-minded ones are utilizing Schrader Air Products, not just to hold work or blow away chips, but to produce complex units to close tolerances.

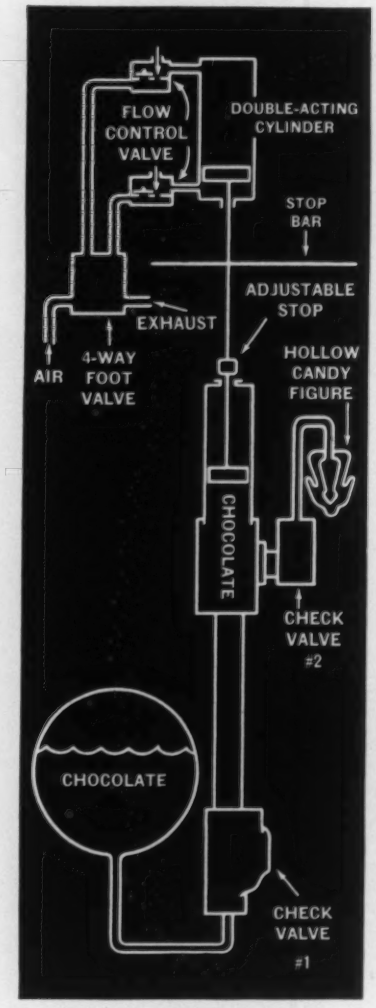
Air is a big boy now. It has grown up fast because automation came because pennies needed pinching. Because many operations in manufacturing turned out to be just plain dangerous. Then engineers found air was not only efficient, economical, and safe, but that products were already designed and produced to make air a logical way of performing hundreds of special jobs.

FOR EXAMPLE:

● Sweet words about air from a candy maker

At a Buffalo, New York, candy company, Schrader Air Products have been used to perform a complex measuring operation. To within one gram! Six Schrader double-acting cylinders are used to fill a bank of six more single-acting cylinders with a prescribed amount of chocolate. When a foot valve is released, the chocolate is forced into wax figurines, exactly filling them. And the entire installation is even covered and kept at a constant temperature to insure the proper chocolate viscosity.

Take a look at the schematic. It shows the arrangement by which the Schrader Air Products are adapted to an operation which might at first seem far outside the limits of air use. It was possible because some engineers put on their thinking caps.



Schematic shows how Schrader Air Products are adapted for precision handling of liquid chocolate.

● Talk about air's advantages being automatic—lend an ear

This is important to you, so don't wander off. When air is used to synchronize motions automatically, efficiency is almost sure to follow. BUT, the natural advantages of air multiply like rabbits. For instance, economy is basic. In many cases it can make the difference between profit and loss. Then, safety margins are widened by the use of special control techniques. Air's simplicity makes possible easy finger-tip and tip-toe operation of tiring hand and foot movements. Fatigue? Who's tired? Production goes up. Modern packaged control sets are so highly developed that most hazards of press operation are no longer applicable. Both hands must be used at once, and cannot stray into danger zones. Any machine using a mechanical clutch, shears, brakes and friction clutches can use special controls.

● We <u>like</u> to be taken advantage of

You can make use of Schrader's engineering facilities. That's why we *have* them. Upon request, Schrader engineers will assist in planning for the most efficient use of air in your plant, and in selecting the products best suited to a given application. Distributors are conveniently located to deliver Schrader Products in the shortest possible time.

Write to Schrader for information. Address A. Schrader's Son, Division of Scovill Manufacturing Company, Incorporated, 471 Vanderbilt Avenue, Brooklyn 38, N. Y.

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ESTABLISHED IN 1844

FIRST NAME IN THE USE OF AIR
FOR INDUSTRIAL PRODUCTION AND CONTROL

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Standardization Pays Off

An important fact that is often overlooked has been aptly phrased "without standards, no automation". Although the value of standardization has been recognized widely, there has been evidenced considerable concern over the detrimental effects of overstandardization to be created from automation efforts. Those who picture a consumer's market full of invariable identical products have failed to comprehend the true character and value of standardization with regard to automation.

The greatest potential field for standardization to permit effective automation involves detail parts and characteristics not generally of concern to the purchaser of the product. This is specially true of hardware, mechanical goods and many other discrete products. Component parts of motors for a line of ventilating fans, for instance, can be identical without affecting or restricting external design of the units. With these details the customer has little interest or even awareness of standards but benefits tremendously by the increased value and reliability effected through reduced production costs and uniformity of characteristics.

In some fields standardization has not only created the necessary climate for economic automation but has made possible the quality necessary to create and expand the market. Today's food, tobacco and drug products are good examples. Once the product is bought, the purchaser fully expects to be able to obtain an exact duplicate at a later date.

Standardization is the answer. Even though the unpredictable customer will never permit standardization to the full extent possible with available mechanical know-how, the degree of automation ultimately achieved—with its benefits in more products available at acceptable costs—will depend upon carefully developed standard parts, products and processes.

For economic and successful automation development, standardization pays off.

EDITOR

WHAT DEGREE AUTOMATION?

Machine tool builders are keenly aware of the potential advantages automation holds for their customers and themselves. In this article the author reveals the high degree of automation that has been developed in the honing process.

By EDWARD L. BEHRINGER
Micromatic Hone Corp.
Detroit, Mich.

EVERY Production, Processing and Tool Engineer realizes that his primary objective is and always has been the finding of ways and means to increase production and improve operator efficiency, while producing better parts at lower cost. The techniques of automation that involve automatically controlling machine activities and automatically handling workpieces within and between processing steps are techniques that can contribute greatly to the accomplishment of this objective.

The degree to which we automate our plants and processes depends largely on product or workpiece, production schedules and available capital. Each engineer is concerned with the degree of automation at some point or points in plant production operations.

A great degree of automation can be found in the oil and chemical industries where the dollar investment per factory employee reaches astronomical proportions. In terms of direct labor cost compared to total cost these industries most closely approximate the completely automatic factory.

In the metalworking industries we are becoming more and more familiar with the transfer type machine that may do hundreds of operations on a single workpiece. This type of installation, while familiar to us all, is not always what we can apply to our own production problems.

But when there is mention of "automatic handling of parts in process and between processes" then most of us begin to take notice. The idea of

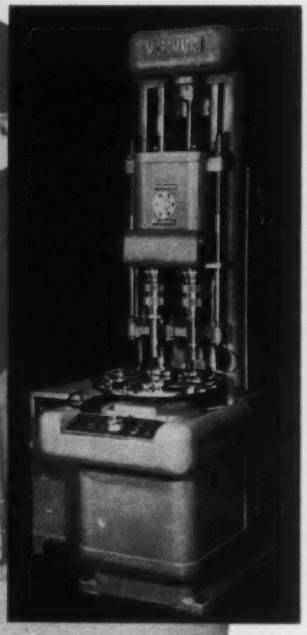


Fig. 1—Increased production is achieved by use of multiple fixtures and multiple spindles—parts are hand loaded while machine cycles.

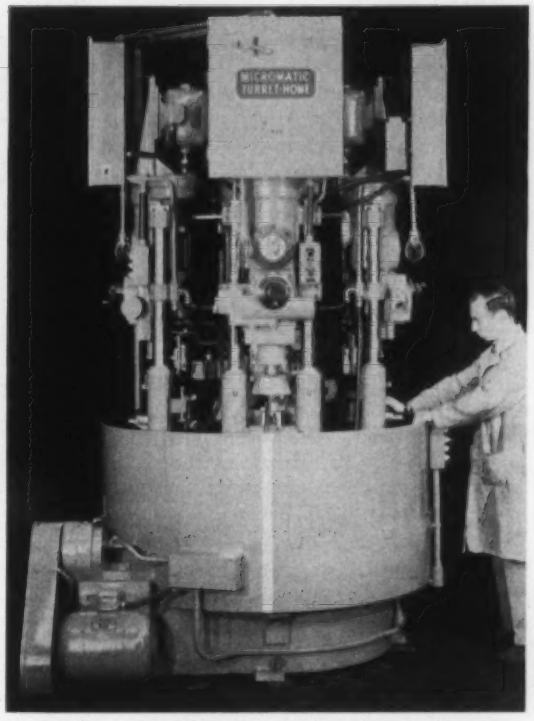


Fig. 2—Four-spindle rotary machine is hand loaded. Turret rotates work stations past operator.

automating to a point that permits the machine to control the output rather than depend on the operator, appeals to all of us in this day of tight production schedules and scarcity of skilled operators.

There is nothing old-fashioned or uneconomical in the "load one—machine one" technique, when you're counting your production in small quantities. Our national production and standard of living have increased steadily under that particular mode of operation.

In the Beginning

The first step towards machine tool automation took place years ago when machine tool builders began to design multiple drill heads and the like.

Increased production was obtained by more machinery, more men and higher cutting speeds. Production was still at the discretion of the operator and the degree of precision dependent upon his skill.

Now, let's consider a key step in any process that minimizes the manual skill and fallibility of the operator. When we introduce gaging and control equipment to a machine that tells the machine when it has finished its job, we've opened the door wide to time and labor-saving methods, and have reached the gateway to automatic production.

Still considering the use of an operator, size control or automatic sizing can do many things.

1. It can relieve the conscientious operator of the tenseness due to the fear of making scrap.

2. A less skilled operator can be used. The operator's role is one of machine manager rather than that of craftsman.

3. Operator's free time can be used to inspect finished production, or load and unload multiple fixturing.

Let's take a look at a few installations where the introduction of sizing alone has been the only step toward automation.

In the honing setup in *Fig.* 1—having a part that is simple to hand load—multiple spindles and multiple fixturing can markedly increase production. With a reasonable work cycle, the operator can keep the machine running on "automatic." With a normal honing cycle of 20 seconds the operator can also perform the inspection operation after each machining cycle.

Another approach is a four-spindle rotary machine, *Fig.* 2. Here again the operator does the

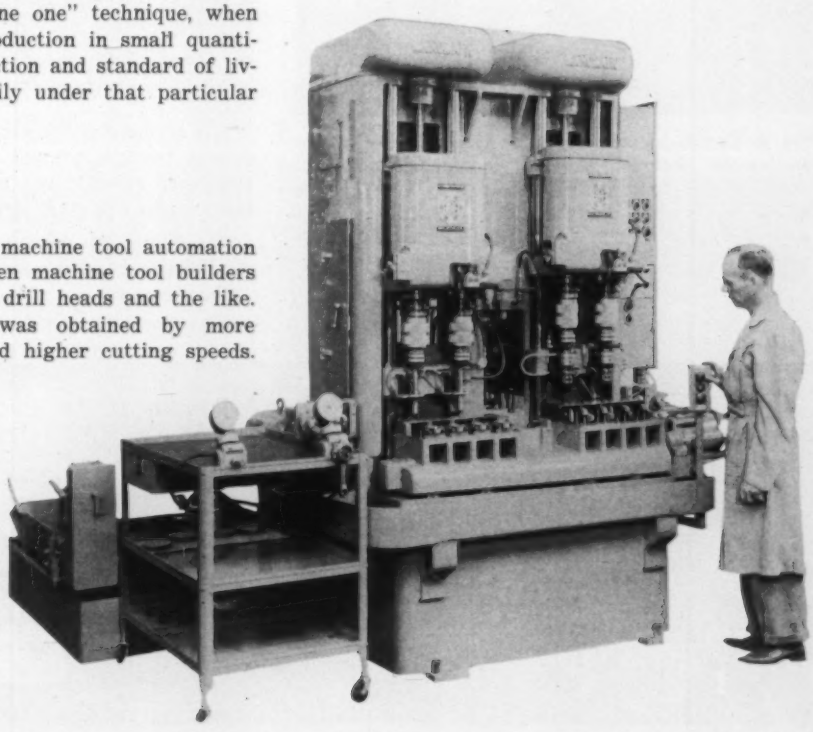


Fig. 3—In-line machine has four spindles and eight fixtures which shuttle between loading and work stations.

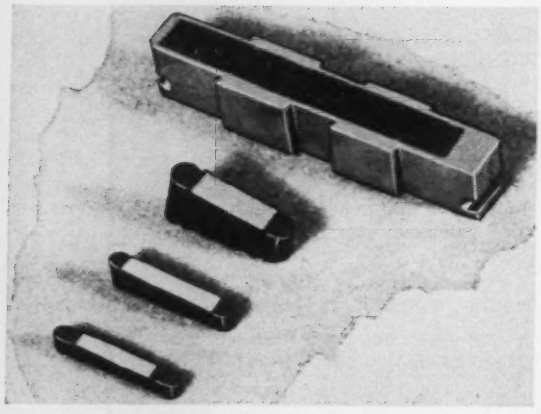


Fig. 4—Abrasive action of the honing process is accomplished by passing the abrasive material over the workpiece at relatively low surface speeds. Variety of shapes shown are abrasive sticks cased in hard plastic for insertion in honing tool.

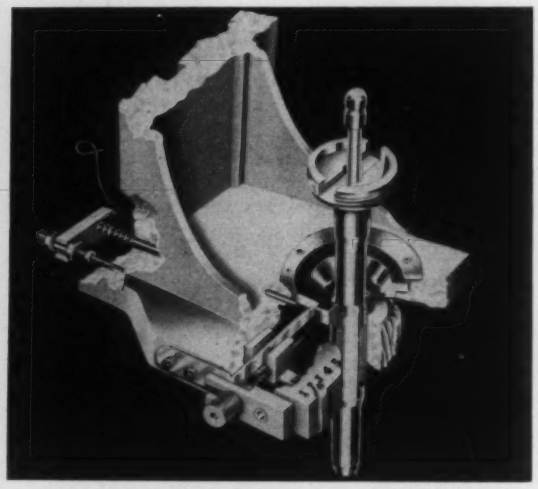


Fig. 5—Details of construction of Gage Ring Microsize mechanism. Rotating, stroking, and feeding action of abrasive inserts enlarges hole in workpiece. When required size is reached plastic tabs on insert rotate gage ring and close contacts which cause machine cycle to terminate.

loading and unloading while the machine does the rest. With the head turret of the machine rotating at 2 rpm, the operator loads, unloads and checks (on an air gage) one part every 7½ sec. Producing 480 rods per hour, this machine demands almost continuous operator concentration.

A succeeding development is a machine with four spindles and eight fixtures, *Fig.* 3. Here . . . while the heads are Microhoning four parts . . . the operator unloads and loads the other four fixtures, and presses a preset start button to keep the machine on automatic cycle. The machine will then complete its cycle, withdraw, index, and begin a new honing cycle without additional help from the operator who has approximately 25 seconds to unload, load and inspect; he also has the comfort of knowing the machine will pause should he fail to complete his part of the cycle in time, in which case the machine will size-out (when ready), withdraw, and await his start-signal.

With this setup 575 parts per hour are being produced, with sizing and the familiar two-position, lateral-index table as the only marks of automation.

These foregoing examples should indicate the necessity of automatic sizing (the termination of the machine cycle by an actual measurement of the workpiece); though it may be the key to automation, it's also difficult to accomplish because we are dealing almost continuously in size tolerances of 0.0002 to 0.0003-inch.

▶ Automatic Sizing

The results produced by the Microhoning process—a round, straight hole with a controlled surface finish—are not only characteristics called for by the process engineer, but are also the very conditions which make automatic sizing easier to obtain.

The chances of the sizing methods used in Microhoning being applicable to other machining processes are remote, but a discussion of techniques may suggest a good approach to other problems.

In almost all small diameter work in Microhoning, the abrasive sticks are encased in plastic.

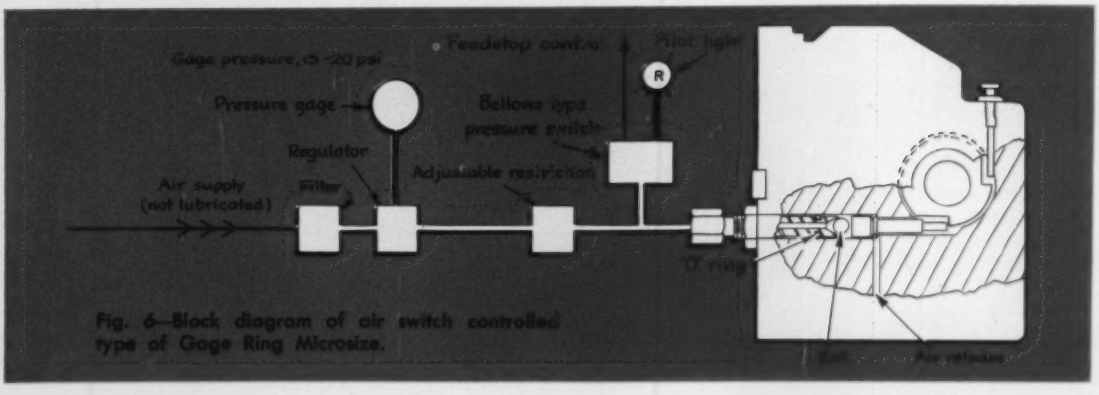


Fig. 6—Block diagram of air switch controlled type of Gage Ring Microsize.

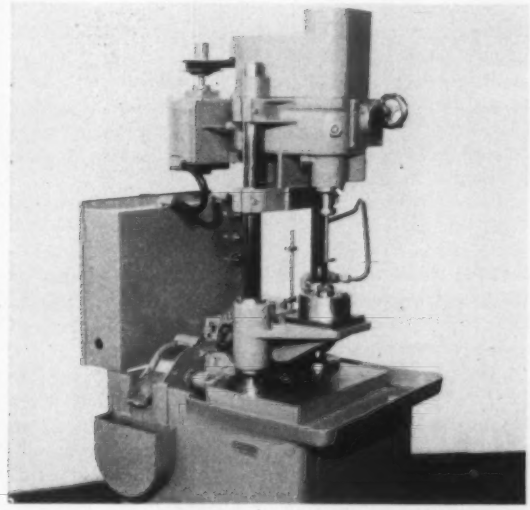


Fig. 7—Single-spindle honing machine with automatic stroking action, but hand operated abrasive feedout. Machine has no sizing equipment and is hand loaded.

These abrasive assemblies are called Micromolds, *Fig.* 4. The plastic serves two purposes. First, by having its bottom face cut to a proper cone angle, the abrasive assembly may ride an expansion cone directly and thereby replace separate expander plates. Secondly, by extending the plastic at the ends of the stick, a tab is provided from which a "to size" impulse can be initiated.

The cutting end of the tool has a number of these Micromolds equally spaced about its periphery. To accomplish hone expansion a cone rod within the tool moves axially, pushing the Micromolds outward against the workpiece. As stock is removed from the bore, plastic and abrasive wear evenly. With the stone and plastic always in contact with the work surface, we have, in effect, an expanding plug gage.

A Norbide gage ring, lapped to the desired final workpiece diameter, is positioned above the part so that only the upper plastic tabs enter the ring at the top of each stroke. *Fig.* 5 shows the tool and a cutaway of the ring and bracket. The ring is free to float so that it can be aligned with the tool, but is kept from rotating by the adjustable tension of a leaf spring. When the bore is "to size", the friction of the plastic on the gage ring causes it to rotate, thereby forcing the grounded leaf spring against a contact which carries a 9-volt bias of an associated thyratron tube. With the grid grounded, the tube fires, picking up a sensitive relay which initiates the first step toward the completion of the Microhoning cycle.

The electronic pickup has been very satisfactory, but an alternate method of pickup which uses air as the switching media has also been employed. This latter method presents nothing new to those familiar with standard air gage inspection equipment.

When using air the grounded, adjustable reed is replaced with a valve body, ball and plunger. Size adjustment is made remotely by varying the air pressure. The pickup works as follows, *Fig.* 6: Unlubricated factory air is filtered and regulated down to 20 psi. With the ring gage and valve plunger normal and the ball completely unseated, the adjustable restriction is adjusted until a "red" pilot light goes on. It is then backed off just enough to permit the light to go out. This leaves a back pressure of approximately 15 psi that keeps the pressure switch prestressed to within 90 to 95 per cent of its trip-point.

In operation the turning of the ring gage causes the valve plunger to seat the ball, with this action back pressure rises and the pressure switch trips, causing the Microhoning cycle to end.

Greater sensitivity and, consequently, an earlier size-signal can be obtained by increasing gage pressure. Thus, by adjusting gage pressure, workpiece size can be "shrunk" or "stretched" a few tenths from gage ring size.

Other mechanisms have been developed by Micromatic for in-process gaging of workpieces during honing. Gage Bar Microsize uses caliper bars built onto the honing tool. Sizing signal is transmitted to the machine controls by air or electronic pickoff equipment. Gage Plug Microsize uses a bellows actuated plug gage that continually attempts to enter the workpiece. Whenever the hole reaches size, air circuit to the bellows sends a signal to the machine that the plug has entered the bore. Gage Air Microsize uses an air gage plug with jets that measure hole size. In this arrangement the plug enters the hole before the final size is reached and the air gage circuit is used to signal the machine controls when size is achieved.

Whether or not you are concerned with the design of the sizing mechanism, it is important to recognize automatic cycle termination for what it is, and then to determine its worth in the future selection and purchase of machine tools.

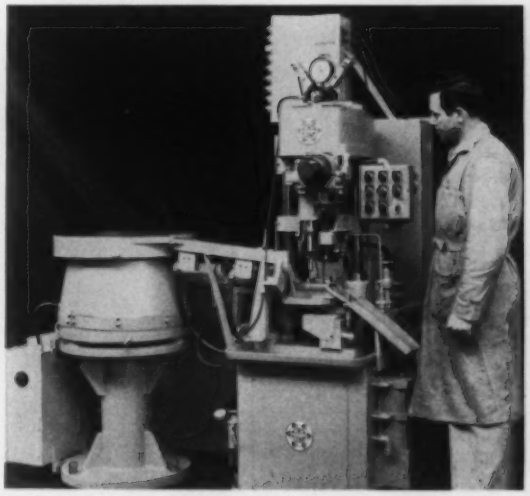


Fig. 8—Automated machine has automatic stroke, feedout, sizing, workpiece handling, and aftergaging features.

Fig. 9—Machine with all of the features of machine shown in *Fig.* 8 incorporated into original design to give more compact result.

Automation Requirements

So far, we have discussed increased production while still keeping the operator as a principle part of the operating cycle. With the introduction of sizing and a few other basic steps the operator's duties can be greatly decreased and the machine made more completely automatic.

In developing a high degree of automation into the honing process Micromatic has concluded that there are three minimum requirements for a honing machine that is to remain unattended—a truly automatic machine. These are: (1) Automatic feeding of the stones, (2) automatic size control of the cycle and (3) automatic handling of the workpiece.

Development of automation of honing can be traced from machines that were hand loaded, had hand feedout of the stones and had no sizing equipment, *Fig.* 7; through machines with attachments to load the parts, to automatically feedout the abrasives, to terminate the cycle by using automatic sizing equipment and to gage and segregate the parts after honing, *Fig.* 8.

Such machines operate with a high degree of independence. Provided with a suitable preoperational parts storage this equipment functions without regard to any part-supplying deficiencies of the preceding machines in the line. Many storage-loaders are now available, one of the vibrational types is illustrated in *Fig.* 8.

General practice is for the loading device to feed parts to a chute on the machine and shut off when the chute is full. The feeder starts again when the chute is almost empty. The control agents are limit switches or photo switches operated directly by the workpieces.

In addition to the sizing equipment that controls machine cycle, automated machines can also be equipped with aftergaging devices to check the machine's work. In the machine shown in *Fig.* 9, as a new part is positioned under the work spindle the previously honed part is moved beneath an air gaging mandrel. The part is brought up to the mandrel by the upward movement of the table. Actual size figures are indicated on a dial and whenever there is a reject, or even a tendency to exceed the tolerance limits, colored signal lights warn of the existing condition.

This machine doesn't correct the few errors it makes, but does weed out the salvageable parts. The two features of aftergaging and segregation are, next to sizing, of prime importance. Although the automated machine is not intended to displace the inspector, aftergaging becomes a logical step. Here is a machine "turned loose" on high production, where the complexity of its sizing equipment is inversely proportional to the allowable tolerance.

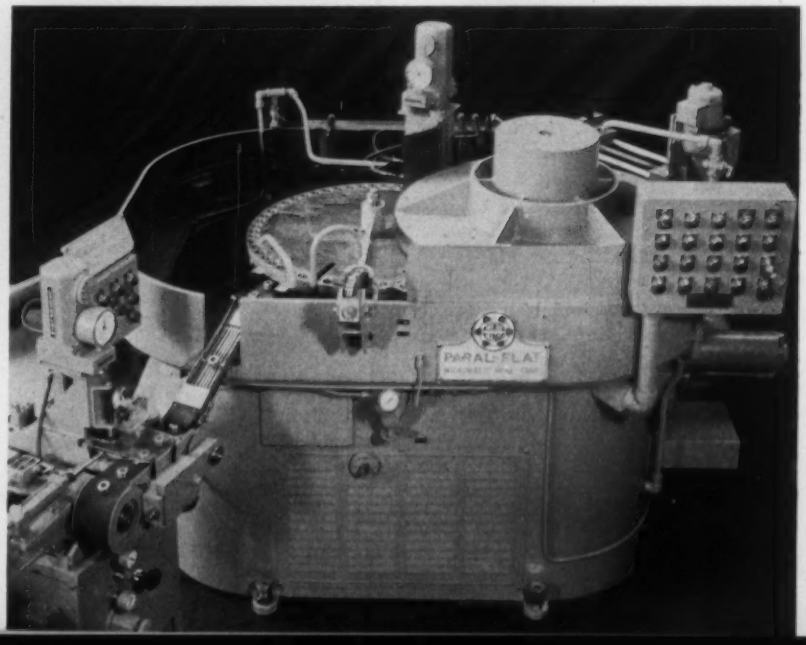


Fig. 10—Machine for achieving parallelism of surfaces of gear blanks passes parts between upper and lower abrasive disks. Device at rear checks part height and controls space between disks by feedback circuit. Gage at front left checks parallelism and shuts down machine for dressing abrasives when three consecutive out-of-tolerance parts are produced.

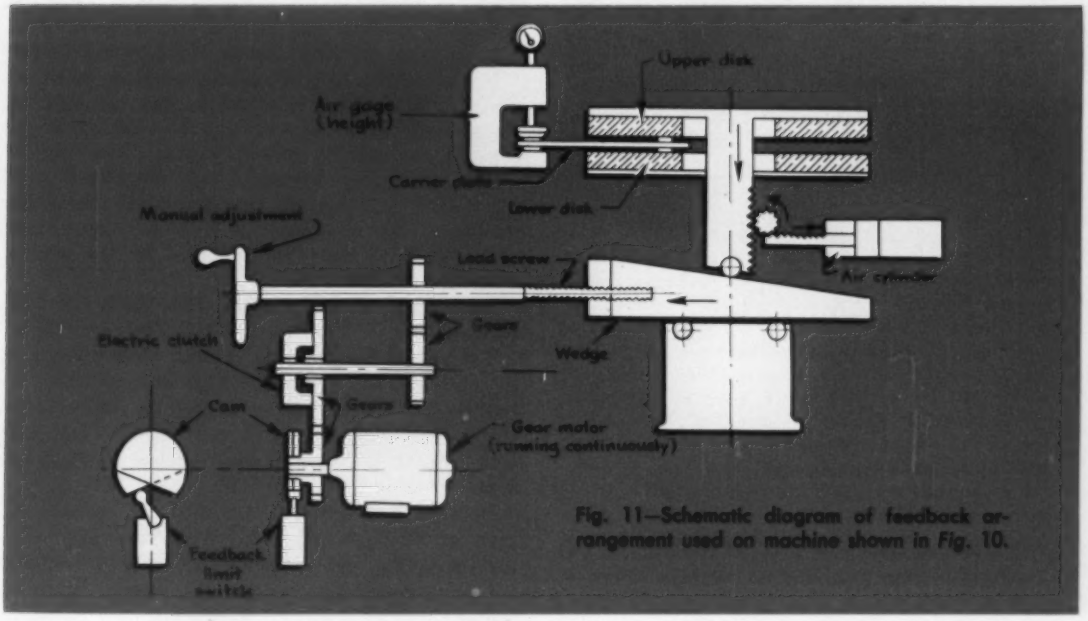


Fig. 11—Schematic diagram of feedback arrangement used on machine shown in *Fig.* 10.

Isn't it only common sense to check the results, throw out the rejects before any more time is spent on them, and stop the machine if the out-of-tolerance part was something more than a sporadic or cyclic error?

This machine will stop rather than dry-run; stop rather than run scrap; and stop if, due to worn-down abrasives, it is unable to complete the task.

In summation then, of our initial concept of a small automated machine, at least these principles should be embodied:

1. It should have suitable preoperational parts storage.
2. It should have a self-controlled demand system of pre-loading.
3. The part should be automatically positioned and clamped under the work spindle.
4. Machine cycle should be terminated by an actual measurement of the workpiece.
5. The machine should be self-checking.
6. Workpieces should be selected and segregated as to size variation as they leave the machine.
7. The automatic cycle should be interrupted if parts are being rejected, or if tools are no longer capable of producing good parts.

▶ Other Considerations

Two other aspects of automation should be mentioned: Pregaging and feedback.

Why pregaging or the inspection of the part before it enters the machine cycle? It probably could be said that if every machine or every process was aftergaged, the need for pregaging would be very small. However, automatic aftergaging is the exception rather than the rule, and in the case of small concerns, where the automation is "in", and "between" processes, complete aftergaging is rare indeed.

Those who design and use today's ideas of automation will undoubtedly agree that higher precision up and down the production line is demanded.

Yesterday's equipment and methods were designed to supplement the skill of the operator. But, today, without the operator to make manual constant adjustments for variations in workpiece and machine cycle, the machine must be manufactured to accept the maximum in tolerances from the previous operation. Very often this tolerance is quite critical, and "junk" thrown at the machine results in jammed fixtures, broken tools and the like.

One manufacturer who is automating his production facilities has asked for final tolerances of 0.0003-inch for size, 0.0001-inch for taper and out-of-roundness, and 0.0003-inch for bore-to-face squareness in the honing of small gear blanks.

To enable the Microhoning machine to run at its greatest efficiency, and in order to weed out the rejects, this manufacturer is inserting an inspection machine in the line, previous to honing. The inspecting device makes eight separate checks and marks salvageable parts four different ways as they leave the machine by way of the segregating chutes.

Feedback in machine tool automation is as natural as was automation itself. It's just another step in the evolution. Rather than just stop a machine when a certain number of parts are processed out of tolerance, how much better it would be if, upon sensing "drift" while reviewing results at the aftergaging station, the machine would correct for tendencies to go off size.

Here again, as in the story of automation itself, it isn't necessary to shift our thinking immediately

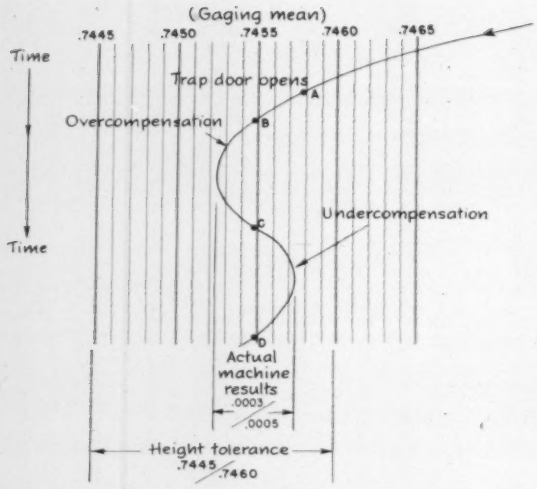


Fig. 12—Chart showing size results of feedback control of height dimension produced on machine shown in *Fig.* 10.

to the super-colossal.

The bore-to-face tolerance of 0.0003 inch previously mentioned, was one of the reasons for Micromatic's initial turn to a machine with the basic elements of feedback.

To achive bore-to-face accuracy of both faces, we must be dependent on parallelism. With a double-surface flat Microhoning machine, the parallelism of the faces could be obtained. Since this parallelism is a function which changes only minutely as the abrasive disks wear, the biggest problem in automating the machine was to feed back part height . . . and contintually and automatically correct for disk *wear,* not disk parallelism.

The final equipment is shown in *Fig.* 10. Parts enter the carrier plate from a storage unit and are carried between the faces of two abrasive disks. The gage in the rear checks the part for height.

In the initial starting of the unit, or after the abrasive is dressed, the parts pass through the disks more than once, riding around on a rail beneath the carrier plate. Feedback continues to adjust the upper abrasive disk downward until the height gage signals that the parts are within tolerance. At this point a trap door opens and parts begin to leave the machine by the way of a small conveyor.

The feedback arrangement, *Fig.* 11, is not complicated.

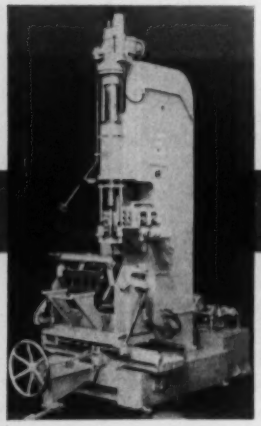
The upper abrasive disk rotates while being held in position by a wedge and air cylinder arrangement. As parts pass between its gaging faces, the height gage indicates part height and also acts on back pressure to open or close an electrical contact.

Because disk wear is very slow, an incremental type of feedback is used. When the gage calls for correction, one other factor must be satisfied before corrective measures are taken. Running continuously is a 3 rpm gearmotor which can be made to withdraw the wedge by the action of a small electric clutch. This motor also drives an adjustable cam which, once every revolution, releases a limit switch. Since the carrier plate is passing 20 parts per minute through the gage and the limit switch is being released 3 times a minute, the switch is being released approximately every seventh part.

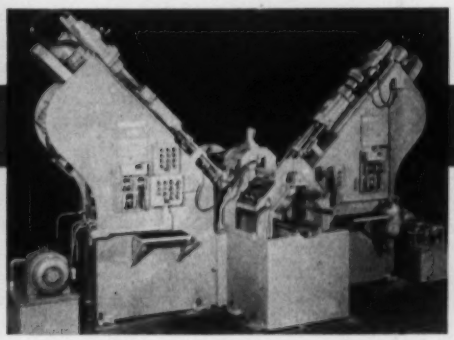
In order for the disk to receive a compensating adjustment, both the gage and the limit switch contacts must be closed. The compensating pulse on the clutch lasts only as long as the limit switch is released. A typical curve of the resulting parts is shown in *Fig.* 12. With the parts 0.002 to 0.003 inch oversize, the curve of part height starts out to the right of our chart and the parts will take several runs between the abrasive disks. Com-

Fig. 13—Five machines show design evolution of machines to automatically hone cylinder bores in automotive V-8 engine blocks.

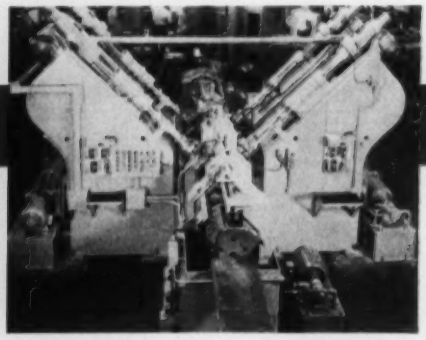
(*a*)—Vertical single-spindle machine tooled with fixture to index each bore in succession into honing position.



(*b*)—Two-spindle machine has one head at angle for each bank of bores. Four indexes produce one complete block.



(*c*)—Four-spindle machine is a double version of machine (*b*). Four indexes produce two complete blocks.



pensation of the upper disk starts and continues to point *A*, at which time the trap door opens and finished parts are permitted to leave the machine. Compensation continues until the parts are leaving the machine at the mean gaging height (point *B*). Compensation stops, but reaction is not immediate and there is a tendency to overcompensate. As the disk continues to wear, part size will creep upward until the mean is again crossed at point *C*. The gaging contact closes, and the next compensating pulse is actuated as soon as the continuously rotating cam permits the release of the feedback limit switch. This lag tends to give a slight undercompensating curve as noted *C* to *D*.

After the workpieces pass the height gage they are brought out to a parallelism checker which checks about every tenth part until it finds one out of parallel by more than 0.0002-inch, at which time it immediately checks a second and a third. If three parts are unsatisfactory, the machine is automatically shut down and time taken for the corrective measure of dressing the abrasive.

THE AUTHOR

EDWARD L. BEHRINGER started at Micromatic Hone Corp. in the tool design section in 1941, while attending the University of Detroit. During the period from 1941 to 1944, he held jobs as maintenance electrician, machine assembly electrician and electrical control designer, in that order. Graduating in 1944 with a B.E.E. degree, Ed immediately accepted a commission in the USNR. Until 1946, he served as Radar Maintenance Officer and then returned to Micromatic as an electrical control designer. Ed was placed in charge of that department in 1947 and became Chief Electrical Engineer in 1953. He is presently on special engineering assignments.

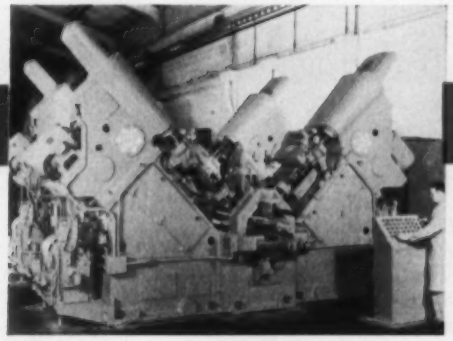
▶ Changing Industry

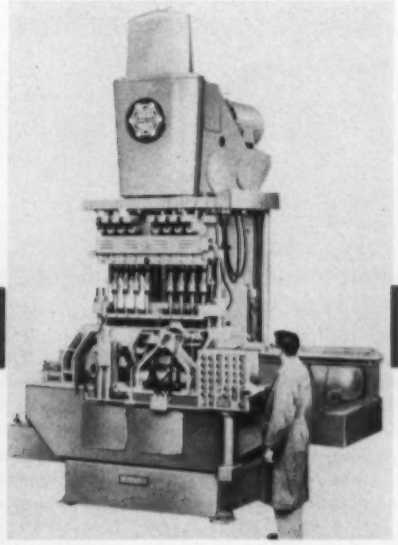
Automation has brought many changes to the machine tool industry. A point worthy of note is that different machines which accomplish the same objectives and utilize some of the same principles of automation can have widely different physical layouts and overall configurations. These differences stem primarily from the decisions of the manufacturing engineers who determine the sequence of operations and the method of workpiece handling to be used in the processing of the part in question. The degree to which multiple spindles and indexing fixtures are used in directly related to these decisions, and the cost of the alternative machine designs as determined by original equipment investment, floor space required, maintenance charges, and expenses per unit of workpieces produced.

The five machines illustrated in *Fig.* 13 are a case in point and are arranged chronologically with respect to design date to show the evolution of machines to automatically hone cylinder bores in automotive V-8 engine blocks.

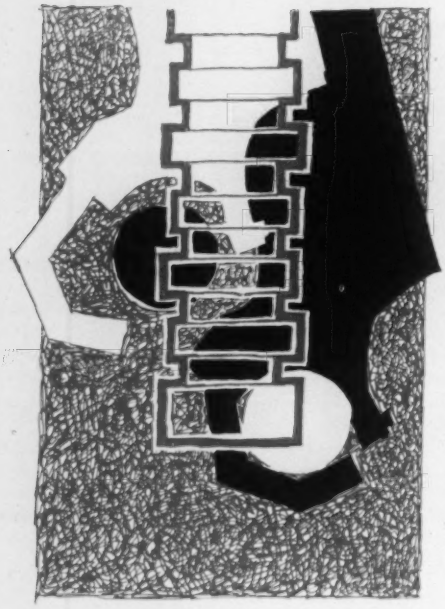
Development of new techniques for all production processes is a continuous activity. There is a degree of automation for every purse and process. Small production shops, as well as large, can be and are being automated.

(d)—Machine has 16 spindles—double banks of four spindles on each side. Each index produces two blocks.





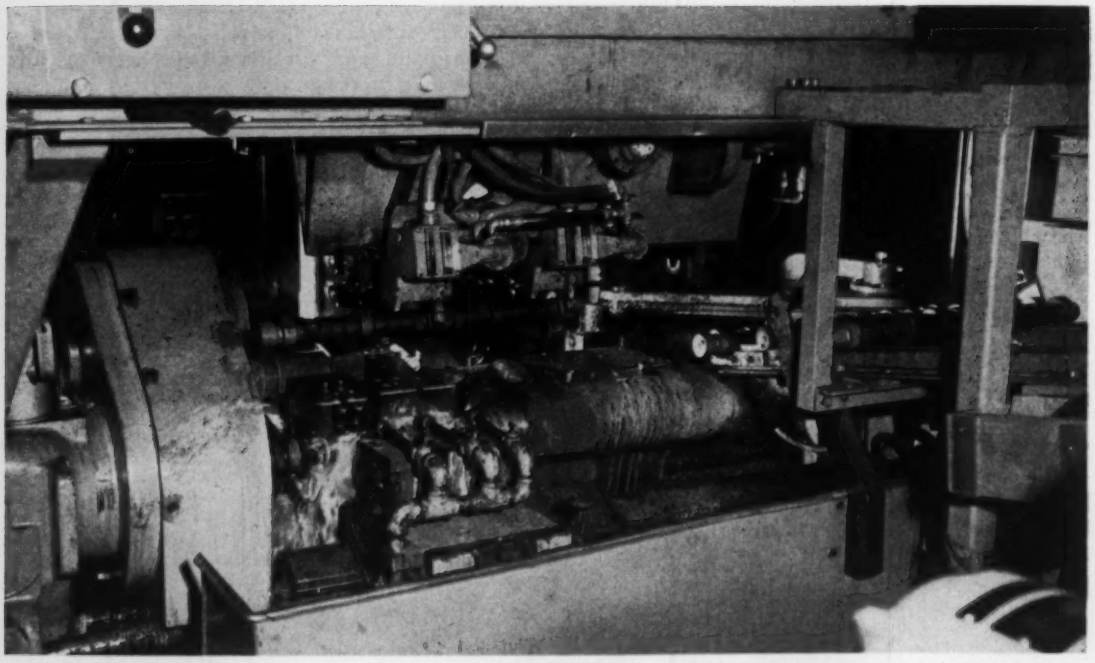
(e)—Vertical eight-spindle machine has two work stations. Block in first station is tipped up to hone bores in right bank. Block in left station is tipped up to hone bores in left bank. Each index produces one block.



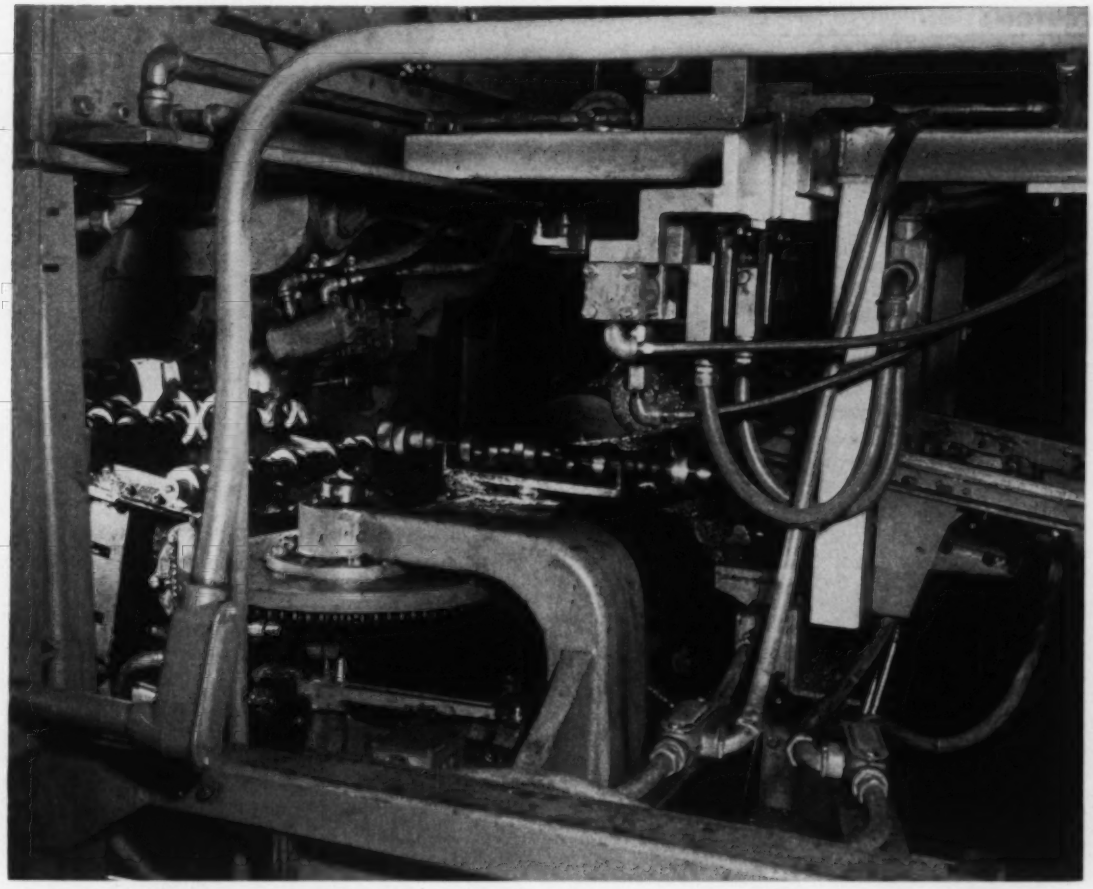
AUTOMATION TODAY

AUTOMATED CAMSHAFT MACHINING

By HENRY IBSER
Master Mechanic
Mound Road Engine Plant
Engine Div. Chrysler Corp.
Detroit, Mich.



1 Lathe receives camshaft castings from previous operation on conveyor that delivers them to inclined rack shown at the right of the picture. Overhead, screw actuated transfer-carrier which is built onto lathe travels back and forth over tailstock to load and unload machine. Loading clamps visible on front face of carrier hold workpiece ready to load. After machining cycle is completed, pair of unloading clamps on back face of carrier descend and withdraw camshaft from lathe; as this workpiece rises above working area, loading clamps descend and place next workpiece into turning position. As loader returns to up position, carrier moves to the right where the unloader delivers machined camshaft and loader picks up next workpiece to repeat the cycle.



2 Turn-around mechanism takes camshafts machined by first Seneca Falls Lo-Swing lathe and turns them end for end, ready to be shifted into first gaging station and then to second lathe. First lathe machines gear-mating surfaces and number 1 and 2 bearing diameters on one end of shafts, then second lathe chucks on that end and machines number 3, 4, and 5 bearing diameters and a gear blank diameter on other end of shafts. Parts are moved from second lathe to second gaging station.

CAST IRON CAMSHAFTS with flame hardened cam surfaces are among major components machined on well automated lines in the new Mound Road Engine Plant of the Engine Div., Chrysler Corp. Before entering the line, the castings are machined to length and both ends are center drilled. One ¼-inch hole is drilled and reamed in the rear end face in a hand loaded drum fixture on a Rhenberg-Jacobson four-station trunnion-type machine at the start of the line. This hole is used to drive the parts during certain machining operations and for radial location in other operations.

From the fixture in this machine, the camshafts roll onto a conveyor and then are advanced down an incline ready for pickup by an automatic loader of the first of two Seneca Falls Lo-Swing lathes that do the turning on the camshafts. Each lathe has a built-in overhead transfer-carrier that has loading and unloading clamps to handle the workpieces to and from the machines.

After picking up a camshaft from the incline, the transfer-carrier advances to a position above the work station. As soon as cuts on the prior piece are completed, the spindle stops, the air operated chuck jaws open, the unloader descends and clamps onto the prior piece, the tailstock quill retracts and the unloader is elevated. Then the loader lowers the new piece into machining position, the tailstock quill advances, the chuck jaws close, the loader retracts and the headstock spindle clutch is engaged.

Thereupon, machining proceeds on the piece just loaded and three front tools finish turn number 1 and 2 main bearings and a gear fit diameter while seven back tools make the facing and the chamfering cuts on half the shaft. Dur-

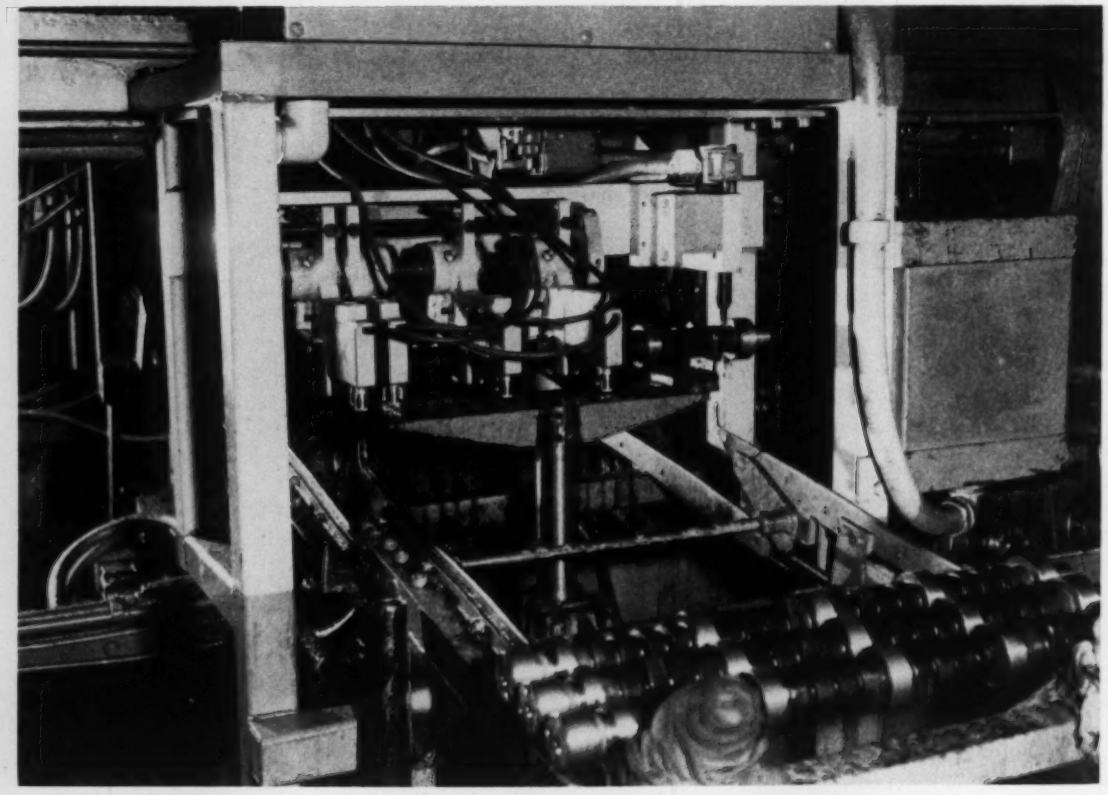
ing this interval, the work carrier transfers a camshaft onto a turn-around fixture which positions the partly machined casting ready to be shifted into a first gaging station and then to a second Lo-Swing lathe.

General operation of the second lathe is similar to that of the first and its loading device picks up the partly machined camshaft with the machined end toward the headstock, leaving the unmachined end protruding from the chuck after the camshaft has been loaded. In the second lathe, number 3, 4 and 5 bearings and an integral gear blank are finish turned. When this machining is completed, the carrier automatically unloads the camshaft and shifts it into a holder in a second gaging station.

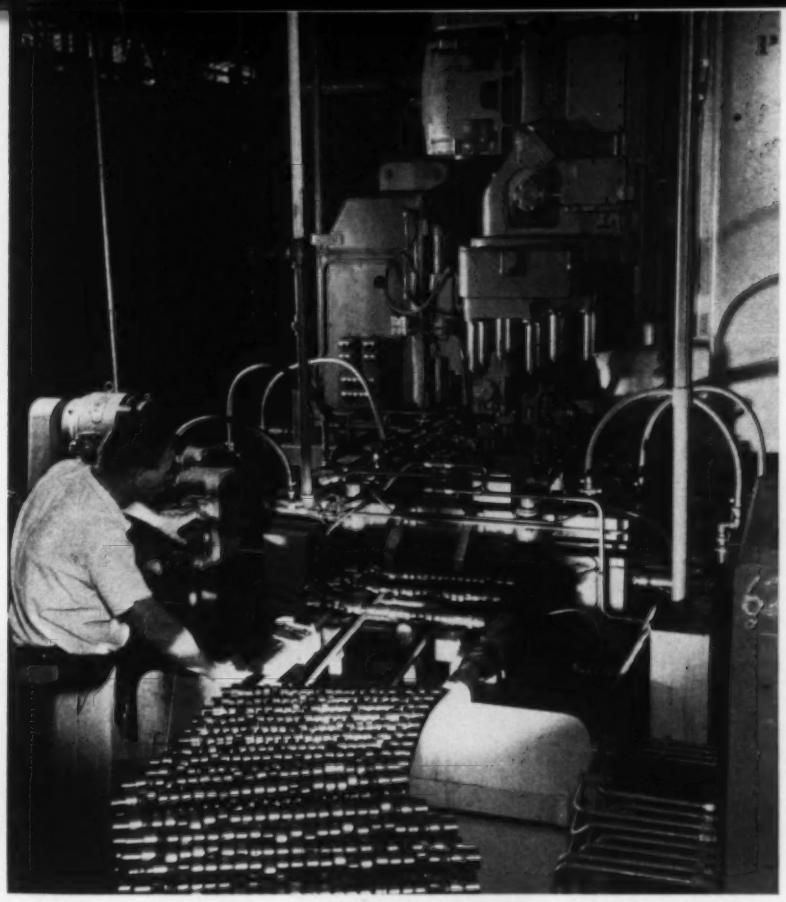
Camshafts discharged from the gaging station are picked up one at a time by an operator and are checked for straightness in an Impco machine. This same machine is employed to straighten any camshafts that are not within design limits. This operation is followed by the grinding operations which finish all cam surfaces.

After finish grinding, the camshafts enter a 17-station Krueger-Barnes transfer machine. This machine performs all of the drilling, counterboring, reaming, tapping and keyway milling required on each shaft. Loading of the feed rack for this machine is done by hand by an operator who presses buttons that control initial clamping. Indexing and other operations are all automatic. This applies not only to the indexing from station to station along the slides of the machine, but to such angular indexing as is required.

At the discharge end of the transfer machine the camshafts feed out automatically and are presented for hand loading into a Lees Bradner gear hobbing machine.

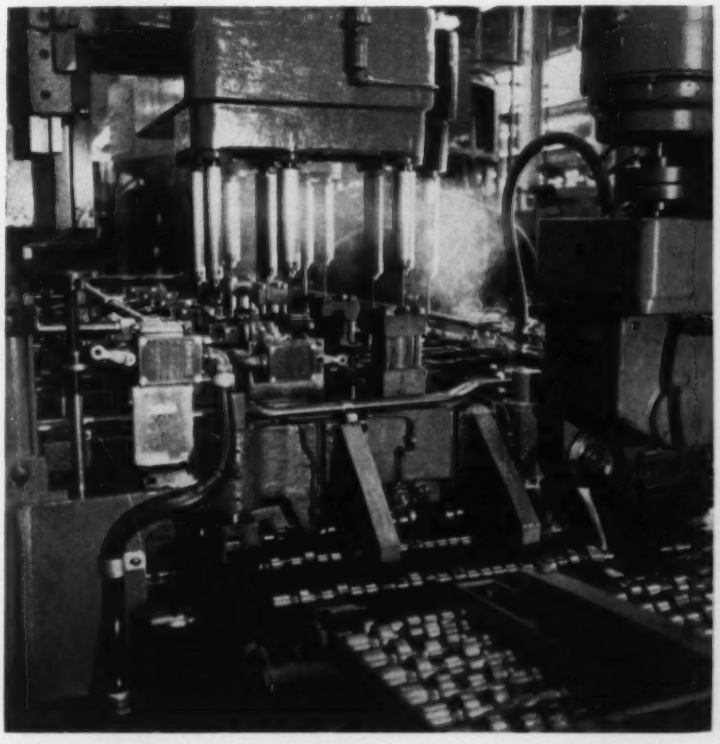


3 This view of discharge side of second gaging station shows Sheffield equipment used to check sizes. Function of gaging stations is such that if all sizes are within tolerance specifications, parts are released immediately from gages. If a size is out of tolerance, part is held in gage and machine preceding gage is automatically stopped at end of cycle for tool adjustment or change. Upon completion of gaging cycle, elevator cradle lowers camshafts onto inclined rails shown in foreground. Parts are then moved to a straightening operation.



4

After straightening operation cam surfaces are ground and then camshafts feed along track shown in foreground. Operator loads parts into 17-station Krueger-Barnes transfer machine. Pushbuttons initiate automatic clamping and indexing of this machine that drills, reams, counterbores and taps holes as required. Indexing features include not only station to station index but also angular indexing of parts to present correct side to tools at each station.



5

Full 180 degree index permits through holes to be drilled halfway from each side by overhead vertical spindles. Drilling machine also mills keyway into camshafts. Finished parts are removed from discharge end shown and taken to hobbing machine where last operation—generating gear teeth—is performed.

MEASURE YOUR QUALITY . . . AUTOMATICALLY

By W. FAY ALLER
Vice President and Director of the Autometrology Div.
The Sheffield Corp.
Dayton, Ohio

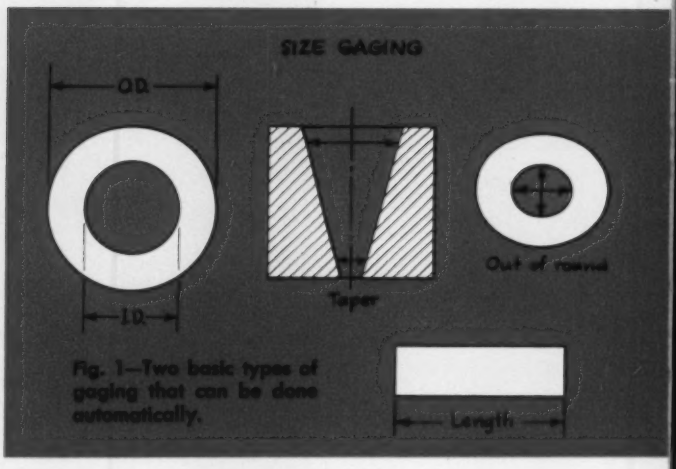


Fig. 1—Two basic types of gaging that can be done automatically.

PRECISE MEASUREMENT, which has gradually progressed from hand methods to semiautomatic procedures in the last quarter-century, is now rapidly evolving into the technique of automatic measurement. This trend is now leading the way to more complete exploitation of metalworking automation's broad potential.

At Sheffield, pioneering work in this field resulted in the development of a complete line of Autometrology equipment — automatic measuring machines and systems integrated with single or multiple combinations of machining, motion or memory equipment. As a result, automatic measurement is becoming responsible for more widespread application of automation to the basic production machine functions such as forming, holding, cutting, etc.

Evidence of this growth is reflected in figures recently released by the American Society of Tool Engineers, predicting that annual capital equipment procurement for automated equipment will jump from 18 per cent in 1956 to 22 per cent in 1957 for all plants, large, medium and small. Most of these integrated operations will utilize automatic production gaging in one or more of its basic forms — in-process, post-process, final inspection and overall monitor control. A further breakdown of these automation procurement figures shows that in the area of least penetration, medium plants, the predicted purchases will be at a 30 per cent level in 1956-57. Maintenance of these high volumes will require that automatic measurement's capabilities, characteristics and basic features become common knowledge among the automation engineers—the systems designers, builders and operating-maintenance men.

Automatic Gaging Flexibility

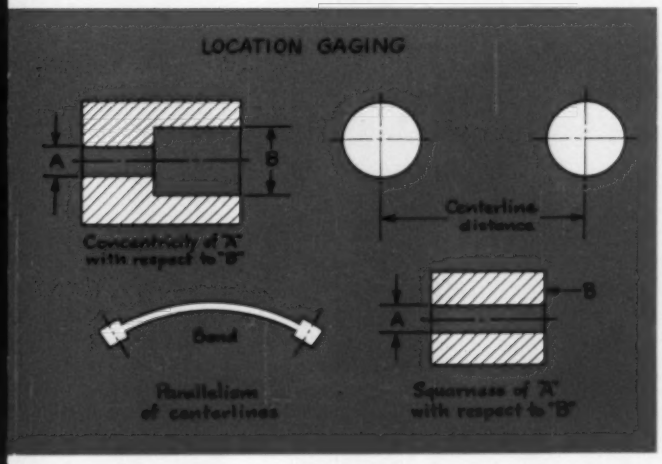
Automatic gaging is highly flexible as far as equipment and function are concerned. It can be adapted easily to a wide range of sizes and products, often without an excessive additional outlay of funds or discarding any existing gaging circuitry or tooling. Evidence of this flexibility is the fact that automatic gaging has been successfully applied to all the basic types of automation systems — circular index, inline index, constant travel and unitized setups. Banking of tools, interchangeability of components and "floating" tooling for both cutting and gaging are a few of the more important equipment design improvements developed as a result of these applications.

With a standard gaging setup, automatic control can be achieved when impulses from the gage tooling are amplified and fed back to an indicator and/or controller. With this controller connected to the machine feed or other operating mechanisms, the gaging system can control the movement of a cutting or forming tool and reset or adjust it "as ordered".

On the other hand, this basic gaging system—mechanical, electrical, electronic or pneumatic—must be able to convert efficiently and quickly and to amplify the initial impulses into an electrical signal or impulse. These resulting signals actually indicate dimensions and control the machine through feedback.

Of the basic types of systems, pneumatic or air gaging has many advantages that make it ideal for automation and it is therefore expanding in

Automatic measurements are proving to be a vital factor in the advancement of automation in the metalworking field. Flexible tooling and controls keyed to gaging are being applied with excellent results to all types of equipment from partially automated single machine tools to completely automatic integrated production lines for functions ranging from tool control to parts straightening. Here is a fundamental element of automation.



use. It can amplify up to 500,000:1 with boosters and its pickup elements can be remotely located. These sensing elements or cartridges can also be placed directly against the work piece from many directions and in relatively inaccessible locations. This permits checking a large number of dimensions in a small area. Air cartridges or sensing elements of the contact and noncontact types are used. Electrical and electronic systems are also gaining in popularity for certain types of work. The combination of air-electric is finding the widest application.

For automatic gaging, each complete system will include cartridge or size sensing elements, plus indicating and amplifying components. These are available as separate units or in integral assemblies or packages.

Utilizing different combinations of these elements and systems, automatic gaging work of two basic types—location and size, *Fig.* 1—can be accomplished with a high degree of success. Gaging of parts for dimensions such as ID, OD, length, depth, taper and out-of-round are the most common. Location dimensions are usually concentricity, squareness, parallelism, bend, twist, and center distance.

It is a well known fact that when a machine is operated manually, it is possible for the operator to function as an inspector, keeping the parts under constant scrutiny from step to step. If any discrepancies are noted, he can reject the parts, but, in actual practice the operator does not perform with 100 per cent efficiency nor detect all potential rejects.

In the completely automatic production line, 100 per cent inspection and quality control must be built-into the line at numerous points or automation's high efficiency cannot be achieved. In many instances this type of control is an absolute necessity if parts are to be produced at the least

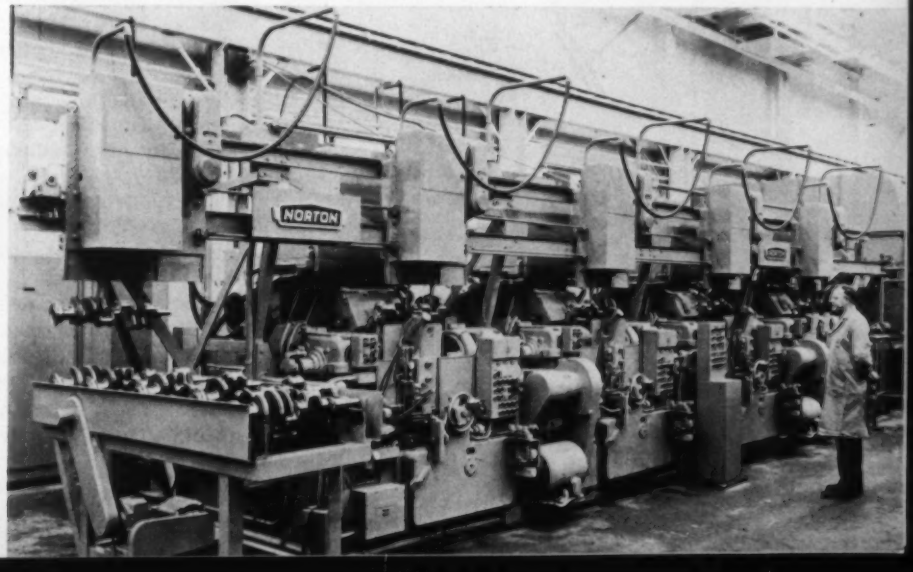


Fig. 2—Transfer type crankpin grinder utilizing gaging control to automatically true and feed the grinding wheels. Controls at each station are used during setting up operations; central station controls all units of the machine.

net cost. Only automatic gaging can achieve this high degree of built-in quality control. To do it, several types of gaging application and machine control can be utilized.

In-Process Control

This type of automatic gaging application provides for machine control through adjustment of the actual movement of the cutting or forming tool while the part is being shaped. A sensing element at the part provides a signal which may be used to automatically:

1. Stop the machine after the tool becomes worn.
2. Change tool feed from rough to finish cut.
3. Retract cutting tool after finish cut.
4. Indicate the condition and size trend.
5. Adjust the tool accordingly.

Due to some basic restriction, this type of control is used primarily for checking and controlling turned diameters. Fixed-size tools such as drills, reamers, etc., are not usually adaptable. In-process gaging, when properly applied, can minimize the production of faulty parts, but it is not always practical due to certain space and positioning limitations.

The crank pin grinder shown in *Fig.* 2 is a transfer type machine that utilizes in-process gaging control to automatically true and feed the grinding wheels during forming. Wheel feed is operated hydraulically, and grinding feed is accomplished through a large diameter feedscrew.

Crankshafts are positioned automatically with the air cartridges applied directly to the crankpin surface as it is ground. When rough ground size is reached, a signal from the gage control starts the finishing cut. When finish size is reached, another signal retracts the wheel slide. Size is held within 0.0002 inch.

In *Fig.* 3, the infeed of an end grinder is controlled automatically by two packaged Lectrolair control units with remote sensing elements. In this installation the air cartridges gage the location of both faces of a gear relative to a centerline. If either or both dimensions exceed the maximum, signals automatically adjust the independent wheel slides to grind within tolerance. Parts are fed automatically into the carrier and are clamped by a chain arrangement.

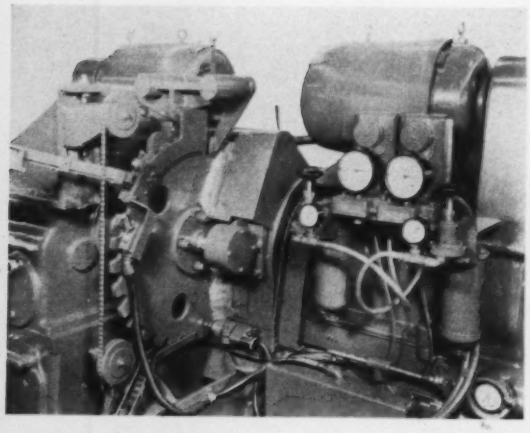


Fig. 3—Automatic gaging of this end grinding operation controls the feed of the grinder. Note gears being fed by chute at upper left and discharged in left foreground.

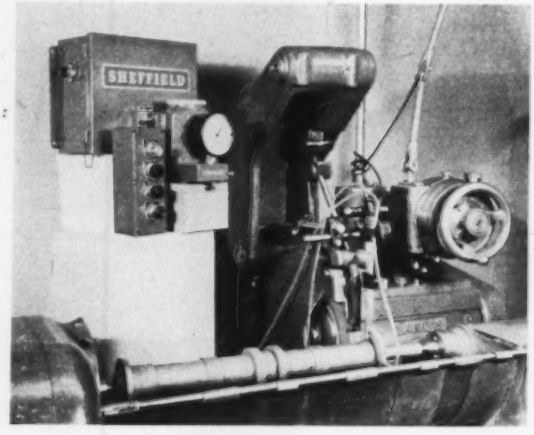


Fig. 4—This grinder is partially automated and can be hand fed or automatically fed as required. Gaging and grinding occur simultaneously.

When partial and flexible automation is the answer to machine control, a set up similar to that shown in *Fig.* 4 could be used. In this arrangement a single grinder is partially controlled. A caliper type gage with Plunjet air sensing elements is mounted on a bracket and connected to an integral gage control unit containing amplifier, dial gage, warning lights and controller. During the grinding of a diameter when the machine is hand fed, the system can produce a signal warning the operator of approaching finish size. If automatically fed, it will change the feed from rough to finish and also retract it when finish size is reached.

Post-Process Control

Station type gaging is accomplished after a specific operation or series of similar operations has been completed. This type of gaging can be performed adjacent to the cutting or forming tool, on the machine-tool proper, or at some remote point. When the latter is used, a single automatic

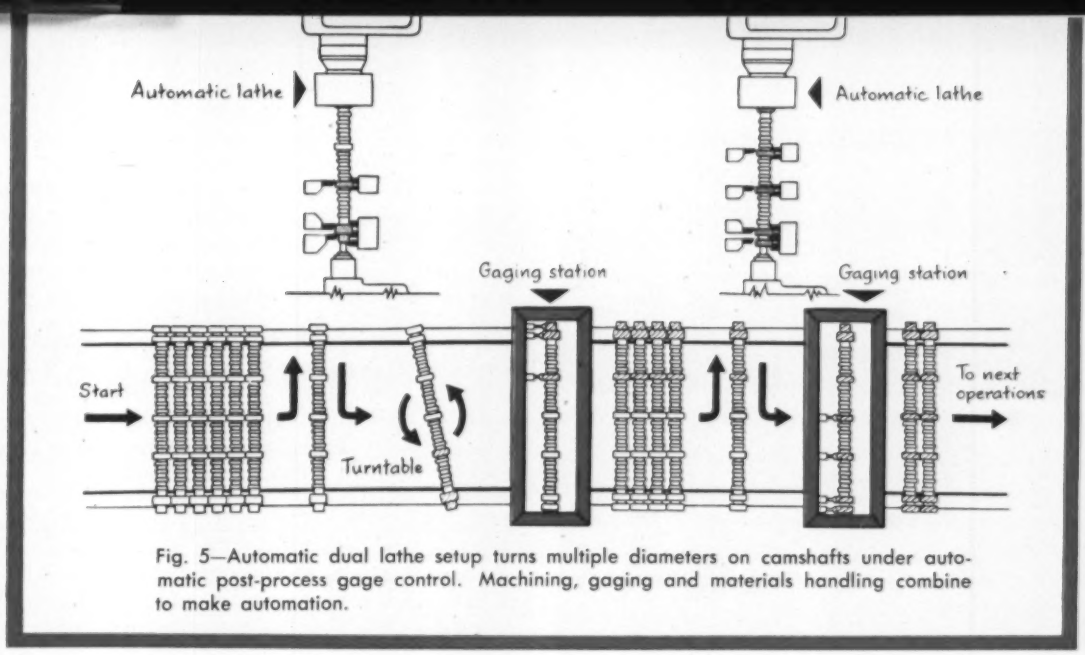


Fig. 5—Automatic dual lathe setup turns multiple diameters on camshafts under automatic post-process gage control. Machining, gaging and materials handling combine to make automation.

gaging machine can be used to check parts from a battery of similar machine tools and control all of them through feedback and a memory circuit. Production rate, type of part and method of processing will determine the best arrangement. A major advantage of post-process or station gaging is the fact that tools, chucks and holders do not interfere and distortion due to clamping, or expansion from temperature increases, is not encountered.

During post-process gaging, the signal fed back to the machine tool can be used to automatically:

1. Control previous machining operation if finished parts are approaching out of tolerance measurements.
2. Remove out of tolerance parts.
3. Stop machine if a specific number of parts are produced out of tolerance.
4. Stop machine because of tool failure or excess wear.
5. Actuate segregating mechanisms.

The type of dimension involved also has a bearing on the type of control signals produced. For example, in gaging center distance between holes or the concentricity of two diameters or the squareness of a hole to a face, tool adjustment signals would be difficult to apply. In that case, the best arrangement would be a warning signal combined with a signal to either automatically remove parts from the line or stop the machine.

Several examples of station gaging, in which the gaging is carried out adjacent to the machine tool, will be described here. They typify many applications in the automation metalworking field.

Automatic lathes of the type shown in *Fig.* 5 are used for turning multiple diameters. In this installation, the lathes are situated in a production line and are interconnected by power conveyors with gaging stations. To start the operation, rough camshafts are placed on an inclined ramp feeding an automatic loader. From this loader the camshafts are "fixtured" in the first lathe and several diameters turned at the same time. After removal from the lathe, these diameters are gaged and those in tolerance are automatically transferred to the next lathe where the remaining diameters are turned. The final step is another gaging operation followed by an automatic transfer to the next processing machine in the production line.

Each gage station utilizes an Electrichek gage head mounted in a special snap gage. Each diam-

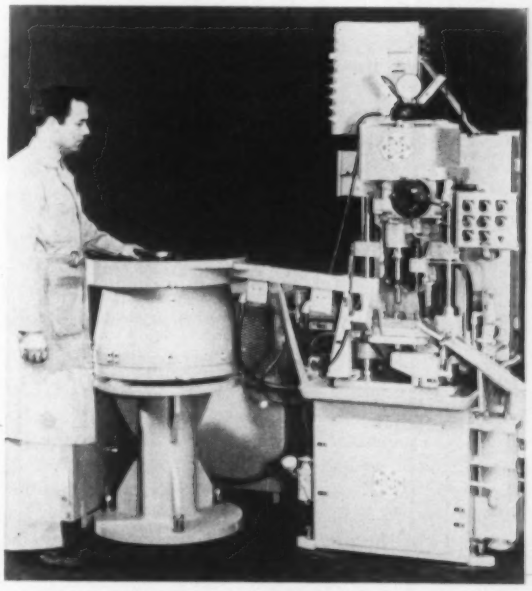


Fig. 6—Small parts are automatically gaged and honed in integrated operations of a single machine. Finished parts are segregated at the discharge point into several different classes.

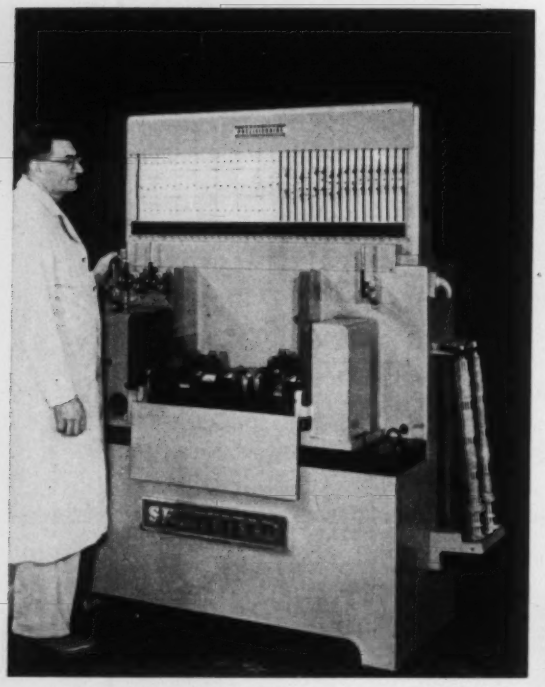


Fig. 7—Crankshafts may be checked for 64 dimensions simultaneously on this gaging machine. Work handling mechanisms provide means to integrate crankshaft gaging into the production line.

eter has a separate gage. Out of tolerance parts produce signals that stop the entire operation. When this happens, the part stays in the fixture at the gaging station while signal lights indicate which diameter is out and whether it is high or low. If they are in-tolerance, the camshafts automatically move to next station without stopping machine operation.

Precision valve lifter holes in engine blocks for one of the newest V-8 engines are also checked by station type gaging equipment. In this case though, gage tooling and circuits are located on the machine tool, in line with the production flow. Lectrolair control units are used in conjunction with remote air sensing elements. Substandard engine blocks are automatically ejected at this point.

In *Fig.* 6, automatic gaging control has been applied with excellent results in the production of small parts. An automatic hopper type feeder is used to position transmission pinions for honing. Gaging and honing are carried out simultaneously by raising a finished part to contact an air spindle element at the same time that a rough part is being fixtured for honing. The remote air gaging cartridge is connected to two Airlectric gage heads operating four signal lights. These lights indicate when a part is oversize, undersize or within 0.0001-inch of the limit. Dial gages also indicate size. At the discharge point the same gage heads also control gates that shunt the checked parts into one of three discharge chutes—OK, salvage or oversize. When a predetermined number of rejects has been produced, the machine is shut down.

In the case of large parts and some heavy production rates, post-process gaging is often carried out on remote units that are completely integrated with the preceding machine tools by feedback and memory circuits. Crankshafts as an example, are now being checked automatically and semi-automatically on equipment of this type. In *Fig.* 7, the operator places each shaft on the test stand by hand and visually checks up to 64 dimensions simultaneously. Precisionaire air flow, column type gages are used to indicate the dimensions.

The same type of cumbersome part can also be automatically checked using dial type gages and package control units. In *Fig.* 8, the center and two main end bearings plus the width of the thrust bearing are checked automatically and simultaneously. If any dimensions are out of toler-

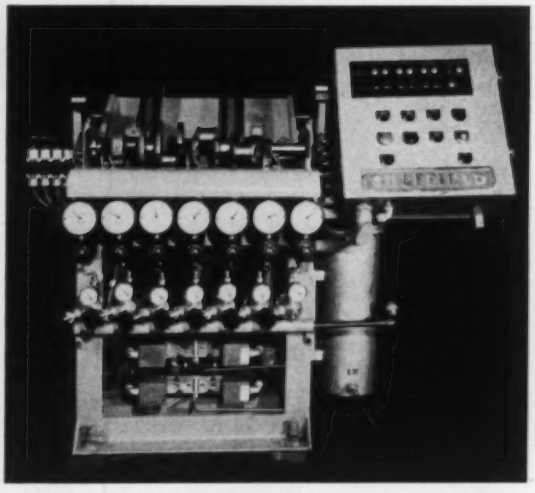


Fig. 8—Crankshafts are checked automatically on this machine using dial type gages and control packages.

ance, the entire line is shut down. The operator then locates the defective dimension from the indicating panel and reads the exact dimension from the respective dial. By the use of automatic work handling devices, of the type shown in *Fig.* 9, the same gaging equipment can be placed in the production line as an integral operation.

The Multi-Feedback device shown in *Fig.* 10 is designed to overcome the costly problem of adapting individual size and machine control units with feedback at each machine to achieve precise, high speed measurement of the parts being produced by a series of machines. It consists of gage tooling with provisions for receiving and measuring precision parts from each of a series of machines. Individual parts are conveyed through the automatic gaging control system through a series of

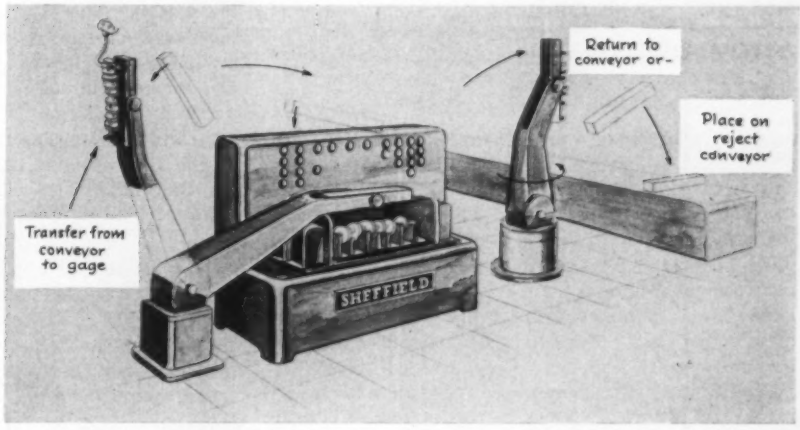


Fig. 9—With the incorporation of loaders and unloaders, cumbersome parts can be automatically gaged in the line, and the preceding machine tools controlled by feedback and memory circuits.

part-handling devices. A memory system positions the incoming parts into gaging stations one at a time as they flow from the different machines.

Controls go into action as each part is being inspected. Electrical gage signals received from the part are transmitted to the particular machine that produced the part. These electrical signals, flashing on a small panel located at each machine, can then be used to stop or correct the machine if it begins producing a predetermined number of reject parts.

In cases where all parts passing through the gaging control unit are not quite the same, two gaging stations are incorporated into the device. In cases where basic dimensions may be the same but overall sizes may be different, a primary gage station inspects the basic dimensions and a series of secondary stations inspect the variable dimensions of the part. Here the memory system performs the additional job of determining which secondary gage station will inspect the part after it leaves the primary station.

The memory system may also be used for a third dimensional quality control function — that of segregating acceptable parts into individual lanes or chutes corresponding to the various types of parts to be produced. Multi-Feedback installations controlling as many as 20 machines simultaneously are in use.

▸ Final Inspection

Although the automatic and semiautomatic units just described are often used for inspection of finished single parts, the final inspection and gaging of assembled parts or products is also being accomplished with exceptional success.

A typical example, indicative of the potential and capabilities involved, is the final inspection of finished rounds of ammunition. A self-contained, fully automatic unit is used in this case for the inspection of profile, alignment, six separate dimensions and the complete weight of each round. It also segregates them into four different tolerance classes. A hopper automatically feeds the rounds into a split-chamber gage station equipped with Electrichek gage heads. After the dimension check has been completed, faulty rounds are ejected. Those dimensionally acceptable slide down a chute to a pneumatic weighing station where they are checked and segregated as either acceptable, underweight or overweight. Each dimension and operation is indicated on a diagrammatic panel equipped with lights that indicate minus and plus values. This compact automatic unit can check as many as 3600 rounds per hour.

An excellent example of final inspection combined with parts assembly is the inspection and

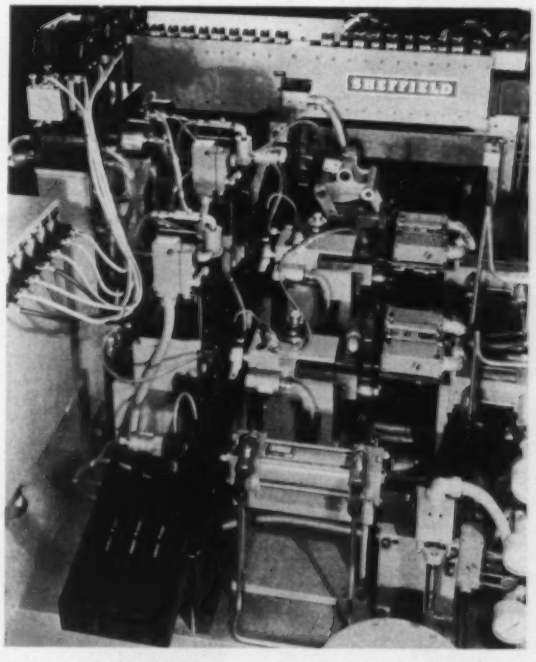


Fig. 10—Multi-Feedback device developed to combine multiple automatic gaging and machine control in a single unit. The system can gage different size parts with common dimensions such as the wide and narrow parts with common diameters shown on the rear rack.

match assembly of tapered roller bearings. The completely integrated inspection-assembly machine shown in *Fig.* 11 automatically assembles tapered roller bearings at the rate of 1000 per hour while under observation of only one operator. Each complete bearing assembly consists of an inner race, eighteen rollers and a cage.

At the beginning of the cycle, finished rollers are loaded, according to size classification, into six separate hoppers. They are fed from this point by gravity as required. Cages and inner races are also fed to the machine from separate hoppers by gravity. To start the operation, a pushbutton is actuated and an inner race moves into position in station 1. Two Plunjet air cartridges then gage the standoff flange thickness. Any out of tolerance parts are rejected at this point. The acceptable races next move to station 2. While this is going on, a special ratchet-loader arrangement feeds eighteen correctly selected rollers to a transfer jig.

This selection of rollers is controlled by a Lectrolair unit with four Airlectric gage heads, embracing six size ranges or classifications. Feedback of previous race dimensions from station 1, through this control unit, actuates an air valve and an air cylinder to discharge the correct size rollers from their storage hopper. The rollers are fed one at a time to the transfer jig until it is full. At the same time, a cage is cross fed to position underneath the race at station 2.

The rollers next move into position over the cage where they are dropped into place. An air cylinder then forces the inner race down into the loaded cage until it snaps into position at the lower level. The assembly next moves up to track level and over to station 3. Here it is rotated past a "finger" to detect any missing rollers. If any are missing, an air cylinder pushes the reject onto a gravity discharge chute.

At station 4, a special die presses a slight bulge in the side walls of the cage to lock the assembly together. If this die does not traverse a required distance and trip a limit switch, the entire assembly is rejected. Station 5 turns the assembly over, to orient it for the next operation.

Final inspection takes place at station 6, where a permanent outer race master is rotated and forced over the assembly under high pressure. By measuring current rise in the drive motor, torque is determined. At the same time, an electronic contact point touches the bottom face of the inner race to pick up any noise that would indicate a misfit. Standout dimension is also checked at station 6 by a Plunjet air sensing element and Lectrolair control unit.

All assemblies are segregated at the discharge point into separate chutes. They are classified according to—OK, standout reject, torque reject, and noise reject. The acceptable roller bearing assemblies are automatically conveyed to subsequent wash, grease and packaging operations. The complete bearing assembly machine occupies a floor space of only 6 x 10 ft.

Overall Process Control

As the metalworking industry progresses toward the automatic factory, the need for central control of all functions, operations and equipment becomes a problem.

Systems control by the monitoring method can provide appreciable control without the use of expensive equipment. A portable Monitorecord,

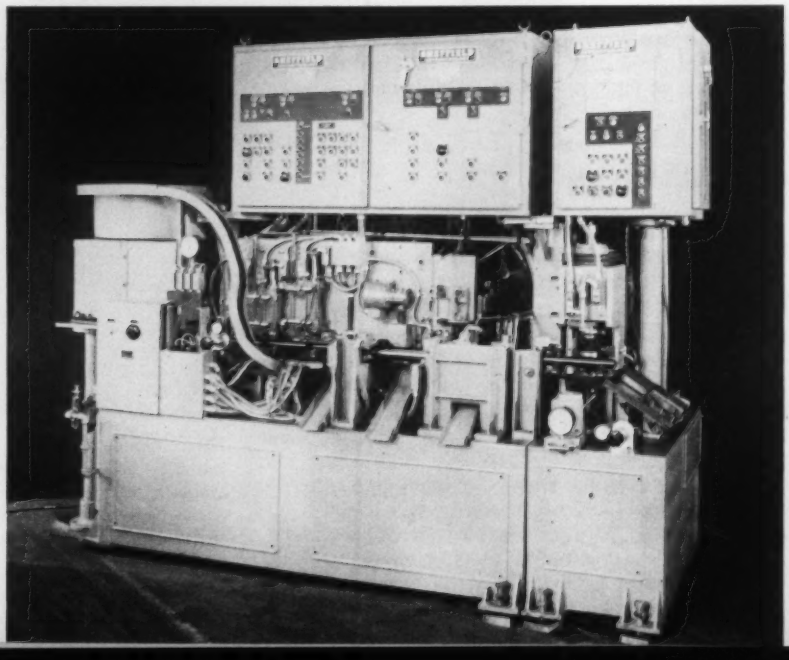


Fig. 11 — Completely integrated machine match-assembles and finish inspects roller bearing assemblies at a rate of 1000 per hour with a single operator.

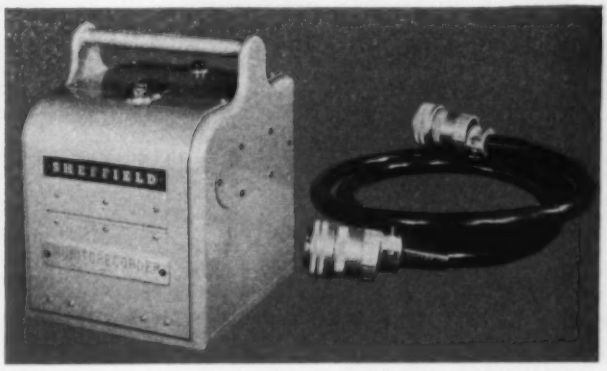


Fig. 12—The Monitorecord can check the operation of up to 14 different machine movements for sequence and accuracy. The Autometrolog shown left can compute the range and average of any series of gaging operations.

an electrical instrument for timing and recording sequential movements of automatic machines, is ideal. It can record up to 14 simultaneous movements on a pressure sensitive, permanent strip chart. By merely plugging it into the circuit to be checked, a magnetically operated stylus is depressed to contact the chart as long as each motion is energized. When the action stops the stylus lifts. When the operator checks this record against the master strip, he can quickly see if the complete operation is in correct sequence.

A practical program of preventive maintenance can be carried out at regular intervals using equipment of this type with only a minimum of operator time required. The results will be lower operating costs, more time on the line and the highest quality production level. The operator can also use the instrument to initially set up any sequential operation by determining what the optimum timing intervals should be and adjusting the machine accordingly.

Another aid to overall systems control is the Autometrolog. It is a portable instrument that computes the average and actual gaging ranges, from successive checks, by merely plugging into a gage amplifier circuit.

A standard deviation chart is used in this compact instrument for recording the values obtained. They are plotted directly on the chart to provide a permanent statistical quality control record of any desired series of gaging operations, *Fig.* 12. It can also be used to quickly determine the production trend for any period of time. For example, if the averages show a consistent gradual trend in a certain direction, the possibility of tool wear could be indicated. On the other hand, if these values consistently vary in their ranges, faulty production equipment would be the probable cause.

The quality level of a product for any period of time can be determined quickly with the Autometrolog. With the unit set to compute the average and range for every 20 successive gage readings, the quality level of a product can be quickly determined from the chart record after 1000 successive production pieces have been gaged. By using both of these monitor control instruments, equipment operation and product quality can be kept under close, accurate control and optimum results assured, for the entire production line.

▶ Planning for Automatic Production

There are many factors to consider in the planning of an automatic production line when feedback gaging circuits are to be integrated. Many have been already pointed out, but there are others of basic importance to the designer and specifier.

Simultaneous production of more than one part in a transfer machine presents a problem when reject handling must be provided. Equipment for rejecting each part individually is often too expensive and space consuming. When pallets are used, this problem becomes even more complicated. The best answer in many cases, even on a completely automatic line, is the use of a *Stop* machine-signal or provision for marking the reject parts for removal at the end of the line.

In gaging problems of this type and others of similar and greater difficulty it is best to call in organizations with the broadest experience in all types of production. Consider the gaging carefully at the outset by consultation with the gage manufacturer. Follow this up with round-table meetings with the machine tool and other component manufacturers and the result will be a completely integrated line with built-in quality control designed to meet specific machine tool, material handling and other requirements.

Among the present users of automation, it is felt that the automating of existing equipment is the least profitable in the long run. Production experience on all types of lines has shown that in most cases it is possible to increase profits

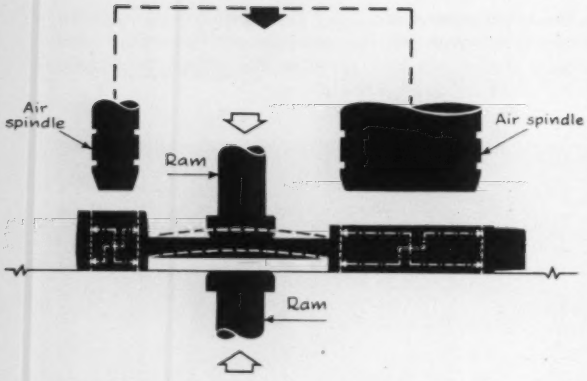


Fig. 13—Cross section of air spindle jig and press ram arrangement used for the straightening of automotive connecting rods bent during processing.

enough on *new* automation equipment to amortize its cost quickly. Therefore, the growing trend is toward the purchase of new equipment, and this permits the designing and application of gaging to the best advantage of all concerned.

Machining operations including forming, finishing and inspection are high on the list of processes most likely to be automated by such industries as automotive, aircraft, refrigeration, air conditioning, electrical equipment, metal product fabricators and precision equipment manufacturers. In these and other future developments, the automatic gage will take over more and more functions from the operator and inspector and machine tools will be designed with built-in quality control initially in mind.

Pointing up this trend is automatic gaging's most recent application to the problem of parts distortion. With the same gaging tooling, circuits and controls now used in regulating product size, automatic gaging is helping to salvage parts distorted during the production process. Applications include such items as axle shafts, valve push rods, valve stems and water pump bearing shafts.

A typical application involves the straightening of bent automotive connecting rods. After completion of the machining operations on a connecting rod, it passes through an automatic final inspection machine. From this point any rods that are bent are transferred to the straightening machine by gravity chute.

As rods move into gaging position, air spindles are inserted in each bore, *Fig.* 13. These spindles are of the double, opposed-port type and they are both mounted on a common jig. Measurements are taken for straightness and parallelism of both bore axes with the air spindles in place and connected to a bank of differential gage heads. Necessary corrections are made after the spindles are removed.

To make corrections, signals from this bank of gage heads actuate a double-ram press with air cylinder and hydraulic booster through fixed increments of pressure. Under control of the gage heads, either the upper or lower ram contacts the connecting rod at a central point, and depresses it by the previously determined amount of force.

After the first corrective pressure application cycle has been completed, both bores are again gaged and a second pressure application made if necessary. If two applications are not enough to correct the bend, the connecting rod is automatically ejected and sent to a manual straightener. In full operation, this automatic straightening machine will follow the pace of the production line.

Many other advanced applications of automatic gaging are being made every day. Inherent advantages of automatic gaging — minimum floor space, reduced direct labor, reduced scrap, improved quality, and the increased possibilities for automatic assembly—are vital contributing factors in furthering the trend toward more complete automation.

CYCLIC AND CONTINUOUS LUBRICATOR

TWO independent lubrication systems, providing both cyclic and continuous oil flow to different bearings on the same machine, are now being built into a single automatic lubricator, by the Bijur Lubricating Corp.

The new lubricator is designed specifically for machines with a dual lubrication problem, where some bearings need periodic lubrication, others require oil continuously. The unit consists of two independent gear pumps with a common drive gear, mounted in a single housing, both drawing oil from a common reservoir in the bottom of the housing. Each pump has its own inlet (from reservoir) and outlet (to distribution line), feeding oil through separate distribution systems to the bearings each serves. At each lubrication point in the distribution systems a Bijur Meter-Unit filters and measures exact quantities of oil fed to each bearing.

The cyclic branch is controlled by a cam-operated valve which bypasses the oil inside the pump and closes at predetermined intervals. This closing action directs the oil into the cyclic distribution system. Since this cam is adjustable, the cycle frequency and duration of cycle can be varied. Pressure periods, or cycles, range from every 5 minutes to every 30 minutes.

The continuous branch is fed by a constant volume pump through its own passageway and tubes inside the lubricator to the distribution system.

A manually-operated Instant Feed Button is included on the lubricator to send a discharge of oil through the cyclic branch distribution system when starting a cold machine. A pneumatic timing device may be included with this mechanism to hold the button down until a sufficient quantity of oil has gone through the system to assure lubrication.

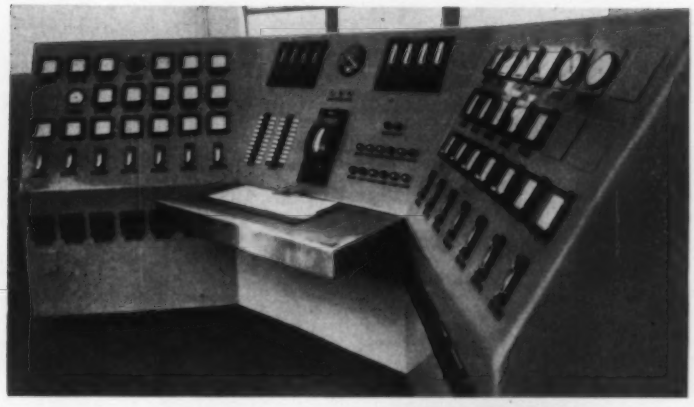


Fig. 1—Electronic recorders, indicators and controllers can be conveniently grouped together to provide for more efficient operations. The illustrated console type is installed at an Atlantic Refining Co. refinery; the graphic panel at a refinery of the Frontier Refining Co.

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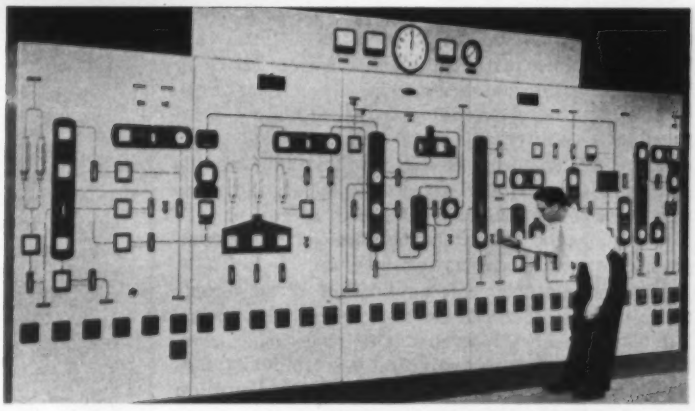


CENTRALIZED CONTROL STIMULATES ELECTRIC TRANSMISSION

ONE OF THE major underlying factors behind the acceptance of electronics by process industries has been the concept of centralized control—the accepted design approach for most efficient operation. Originally as system designers considered centralized control, it soon became apparent that grouping recorders, indicators, and automatic controllers on a common panel board offered the only practical answer to burgeoning plant complexity. Complete control requires centralization of measurement and controlling devices. Today, this trend has led to use of electrical transmission as an ideal solution to the problem and different types of practical centralized control panels have been developed around electronic components, *Fig.* 1.

Instantaneous electrical transmission from the point of measurement to the remotely located controller and back again to the final operator combined with infinite sensitivity of an all-electronic controller has resulted in unusual plant control. For example, control variables such as temperature and pressure are being held to one part in ten thousand in a refinery processing unit.

Electronic control is especially well suited where automatic data loggers are used. All print-out systems ultimately require electrical inputs. Hence, electrical transmission obviates transducing from air signals. Several such combinations of electronic control systems tied in directly to data loggers are in service or under construction.

When confronted with relatively complex process requirements, the flexibility afforded the systems designer with the use of standard electronic components assumes added importance. An example of the inherent flexibility of the electronic

control approach can be found in a completely automatic pipeline pumping station. The control board for this station is shown in *Fig.* 2. In operation, a relatively simple electronic switching system continuously monitors controller outputs. Although one variable normally determines the position of the control valve, any other variable can take over in the event it becomes critical. The monitoring and switching is accomplished by a combination of cathode followers, one for each controller used.

As might be expected, the application of electronic controls has resulted in the increased use of nonpneumatic valve operators. Both electrical gear driven operators and electrohydraulic types are being applied to process control. Both types can be furnished with suitable valve positioners designed to compare the output signal of the electronic controller with the valve position and take corrective action as necessary. Although these operators are more expensive than the conventional pneumatic counterparts on a direct cost basis, the absence of compressed air systems makes this approach increasingly attractive. It appears also that performance advantages are to be gained with electrohydraulic operators because of the incompressibility of the actuating medium.

However natural the application of electronic techniques to industrial process control might seem, it must be remembered that it is nevertheless relatively new. This country's first electronically controlled refinery unit was only placed in operation in 1954 although the concept of the electronic approach to process control and the means for accomplishing it were available a number of years earlier. The Swartwout Co. introduced their Autronic System in 1951. The last five years of instrument technology have seen the advent and rapid growth to today's comprehensive electronic control systems. Indications are that the next five to ten years will establish the electronic approach as a valuable method for plant instrumentation. To give but one example, considerable attention is being paid today to the use of real-time computers for optimizing automatic control of large scale plants. This concept is fundamental if true plant automation is to be achieved. Electronic control systems with electrical transmission and electrical control point inputs are natural complements of such installations.

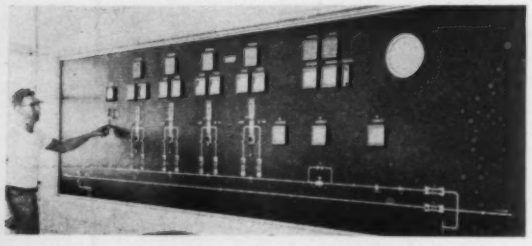


Fig. 2—Control panel of a completely automatic pipeline pumping station for Platte Pipeline.

TAPE CONTROLLED WORKTABLE UPGRADES EXISTING MACHINES

IN THE GENERAL SENSE, machine tool automation depends upon three fundamental requirements: The cutting tool must be capable of automatic cycling, the workpiece must be subject to automatically controlled movement, and the two must be co-ordinated in some intelligent manner. Automatic cycling for most machine tools is a well-proved capability and, though limited, significant gains have been made in the requirements involving work movement and co-ordination. The advancements are of interest to both small and volume producers. A recent development highlights the type of progress which is being made in this respect.

To enable manufacturers to take advantage of existing machine tools having automatic spindle operation, the Allison Equipment Co. has developed a fully automatic worktable which can be used as an auxiliary item for a basic machine. The unit consists of a portable worktable and its companion control console. Table motion, which is controlled by magnetic tape, is along two perpendicular axes in the horizontal plane.

The system uses ½-inch magnetic tape on which seven channels of information are recorded. Four channels are used to produce the table motion; one stops the tape during machining; one controls the spindle movements of the machine to which the table is attached; and one rewinds the tape when a part is finished. The tape length holds enough recorded information to produce 40 minutes of table running time—which is independent of tool operation time since the tape stops during machining operations.

Recording of information on the tape is accomplished by manually directing the table through a desired production sequence. Each axis has its own control potentiometer and position indicating dial and counter. The table can be moved under its own power to any desired position by first manipulating certain switches on the control console in the proper manner, and turning the control potentiometer dial away from its center position in the direction of the desired lead screw dial rotation. Table speed is proportional to potentiometer

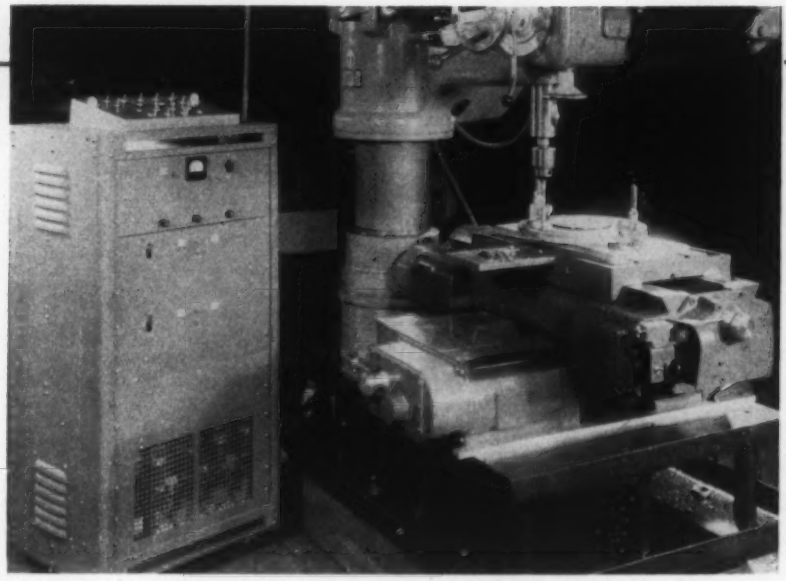


Fig. 1—Control console and portable automatic worktable attached to radial drill. Magnetic tape in console controls movement of worktable and actuates cutting tool.

displacement. For recording the table would begin at some reference point. As the control potentiometers are adjusted to move the table to a desired position, the magnetic tape also runs and the table movement is recorded exactly as it occurs. When the table reaches the desired position and control potentiometers are returned to a balanced condition, the tape stops so that any delays occurring at the position will be eliminated in playback. To record, for instance, a drilling operation at the desired point, the proper switches are manipulated on the control console, and the tape runs an additional length of time to record a signal calling for the up and down operation of the drill head.

Although most recording is accomplished by manual operation of the table, tapes can be prepared for milling circles, arcs and odd shapes by using special recording equipment. Of interest to the small job shop, it is possible to buy prerecorded tape sections for these movements and splice them into an existing recording rather than invest in more complicated recording equipment.

When the last machining operation has been recorded, the table is returned to its indices or starting point and the tape is rewound. To make parts, the operator need only place a new blank on the table and push the appropriate button after a switch is set for record playback. The machine will go through all of the exact movements, spindle control, tape stops during drilling, and tape rewind that were recorded by the original manual operation.

Recordings can be stored for future production, or, if no further parts are to be made from the recording, the tape can be reused for other parts. To prepare duplicate tapes, receptacles to tie two machines together have been provided. To make matching right and left hand parts from a single recording, control switches have also been provided to reverse all movements of either axes. Other control switches allow the operator to stop the automatic sequence while the part is being made to inspect drill sharpness, depth setting, etc. Also, a switch is provided to automatically restart the tape immediately after rewind for making a series of small parts strung out along the table's top.

After an original recording has been made, use of this type of equipment reduces operator time to a minimum because the operator only places a blank on the machine and starts the sequence for each part. Since it is a simple operation requiring no extensive operator training, this means that unskilled operators can run several machines. With the elimination of the human element, the quality of the part has improved because of increased accuracy and uniformity—and rejects are minimized.

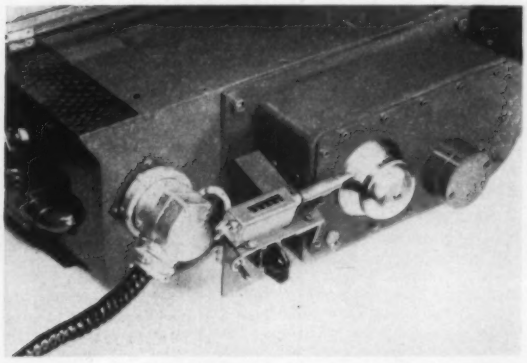
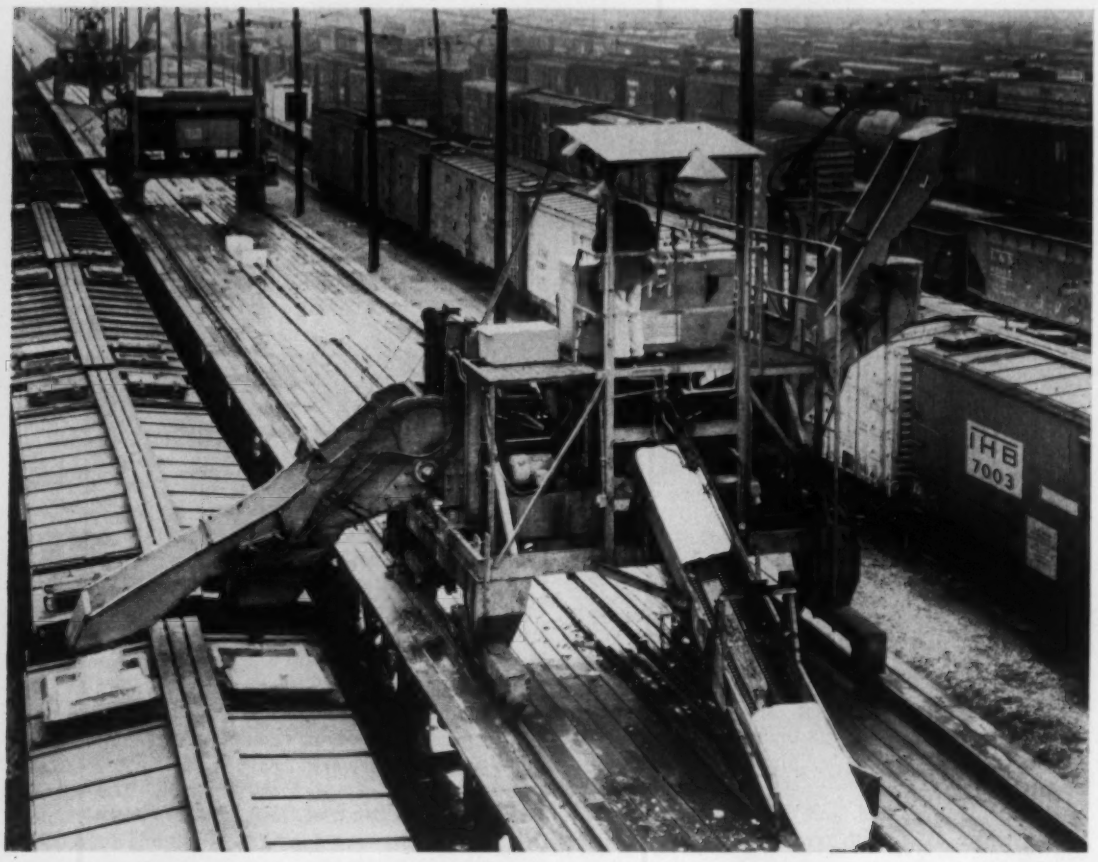
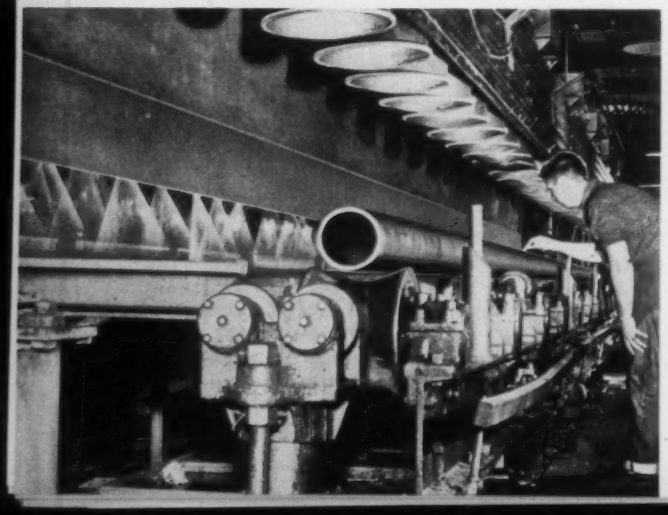


Fig. 2—Worktable is provided with controls for movement in both X and Y directions. Manual adjustment of these controls to obtain a desired movement of the table also records the movements on magnetic tape for machining of additional parts.



Icing Refrigerator Cars

PERISHABLE FOODS move to market faster because of improved ice handling equipment developed by Link-Belt Co. Refrigerator cars require frequent re-icing in long movements during summer weather. City Products Corp., operator of 154 icing and de-icing stations along rail lines, has re-iced 1400 cars in one day with type of equipment illustrated. Shown are two icing and one salting machine. Operator in cab of self-propelled icing machine controls the position of the unit along the track in locating discharge chutes over proper hatches of the refrigerator cars. Ice is scooped up as needed from conveyor traveling down center of dock, and operator adjusts controls to deliver required size of crushed ice to individual car. The pickup conveyor feeding the individual machine can be raised to allow ice on the dock conveyor to pass under the machine.



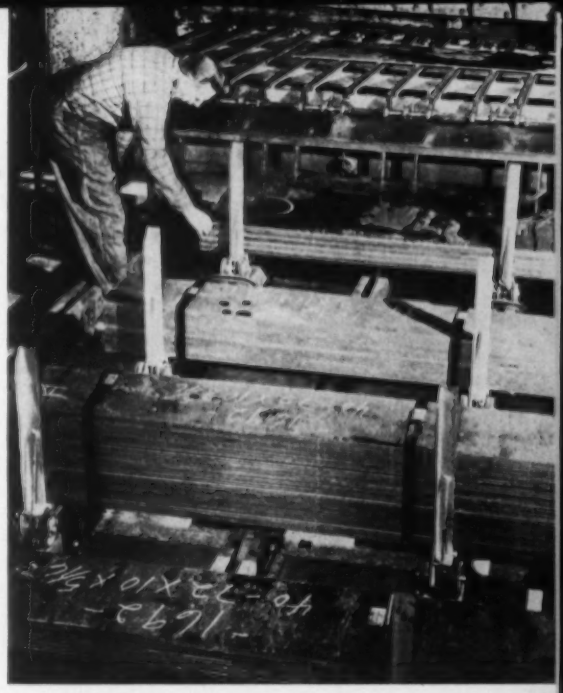
Pipe Inspection

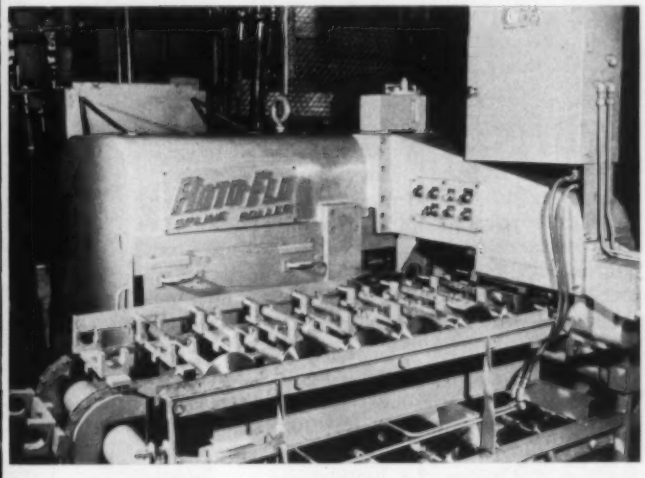
MAGNETIC PARTICLE detection of surface defects in large pipe and tubing is accomplished at Spang-Chalfant Div. of the National Supply Co. Pipe is shown under 34 overhead lamps which flood pipe length with black light. The unit being inspected has just rolled out of spray area where pipe has been sprayed with water containing suspended fluorescent ferromagnetic particles. On other side of spray, individual lengths of pipe are automatically positioned in fixture where 2-foot long scissors-like contacts are inserted into both ends of pipe. The pipe is directionally magnetized by 6000 amp of full-wave direct current at a maximum voltage of 22v to produce a circular magnetic field in the pipe wall. The pipe is automatically passed through the spray where particles in the liquid are attracted to surface defects in a pattern which is made visible by fluorescence under the black light.

in action

Handling Sheared Plate

SHEARED PLATE is handled efficiently, and without inherent danger found in manual handling, by two pieces of equipment manufactured by Fried Steel Equipment Mfg. Corp. At a Lukens Steel Co. plant as plate is sheared, a Liftveyor supports the plate from beneath as it rests against the back gage of the shear. After shearing, the plate is put on conveyor chains and carried to a stationary stacker. When fully loaded, the stacking fixture automatically rolls down to the stacker bed, storing the cut plate neatly. The two pieces of equipment and one worker who checks the plate can accomplish as much as three manual operators formerly did with a crane and a flat top stacker.



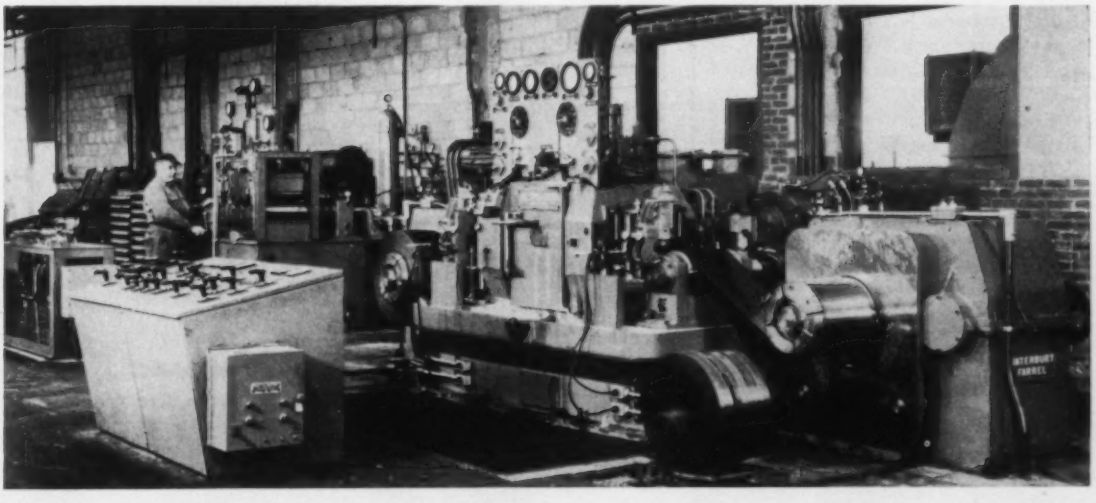


Spline Rolling

CHIPLESS machining of splines on rear axle shafts at Ford Motor Co. is accomplished with Michigan Tool Co.'s Roto-Flo—a cold rolling machine. Parts are moved from an overhead conveyor and loaded into a V-shaped carrier slot loading station; after the splines are formed the workpiece is sent to heat treat operation. Production rate of equipment is approximately 270 per hour per machine (90 per cent efficiency). Rolled splines are produced with a 3 to 6 microinch surface finish.

Steel Strip Production

SEVERAL automatic controls provide for better uniformity of strip and greater accuracy in the gage of steel rolled on a new mill at Barnes Steel Div. of Associated Spring Corp. Strip is held in correct alignment with axis of the coiler by means of an Askania automatic edge positioner. This unit provides for lateral adjustment of the payoff reel through hydraulic means if the strip deviates from a correct alignment which exactly splits the air flow in the sensing head of the edge positioner. Consistent gage control is accomplished by the use of a Pratt & Whitney automatic screwdown control. This unit functions whenever the strip is outside the desired gage tolerance and actuates hydraulic powered screwdown equipment to increase or decrease the roll opening until correct gage is obtained.



PAINTING SWITCH HOUSINGS AUTOMATICALLY

By **WALTER GAGE**
Finishing Foreman, Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

AN AUTOMATED painting operation installed at Micro Switch Div., Minneapolis-Honeywell Regulator Co., in July, 1956, paid for itself in a few months. The setup paints as many as 945 switch housings per hour and makes it possible for 3 men to paint in 3 hours a quantity of housings it would take 8 men 16 hours to do using hand spray methods. Besides increased output and man-hour savings provided by the installation, uniform coatings are assured because variations and effects of operator fatigue are eliminated.

Heart of the operation is an automatic spray painting machine produced by Binks Mfg. Co. In this machine the parts to be painted are carried on rotatable spindles, past a pair of spray guns. One man puts the switch housings on the spindles, one part per spindle, as they pass him on the spray machine conveyor, *Fig.* 1. After the spindles move into the spray booth, a wheel on each spindle engages a belt which causes the spindle to revolve as it passes the spray guns, *Fig.* 2. Just before the revolving spindle reaches the spraying area, a small dog engages a spray starting mechanism and the spray cycle begins. After the spindle passes a set point, the dog disengages, the spray stops and the spindle moves away from the belt and out of the booth.

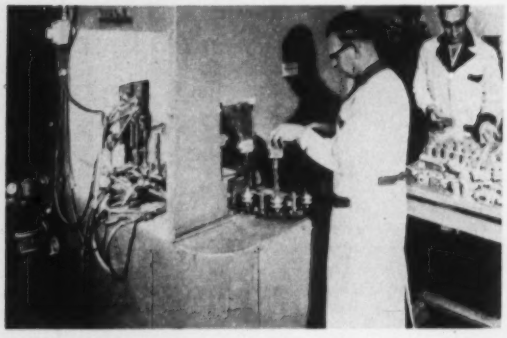


Fig. 1—Machine for automatic spray painting. Guns are automatically turned on and off as parts rotate past them.

Volume of paint spray and the speed and length of the conveyor belt were engineered to meet the painting and drying needs at this plant. By the time the painted switch housings complete their circuit through the machine they are dry and ready for removal from the spindles by a second operator.

To meet the special needs of this painting operation, the Micro Switch materials and process engineering department developed a method for holding the housings which could be adapted to the variety of round, square, oblong and irregular shapes to be finished. The basic spindles on the machine are fitted with extensions of proper length to carry the parts at optimum painting level. The parts are carried on the spindles by special plastic fixtures, *Fig.* 3, which are mounted on the spindle extensions. Parts to be painted fit down over sections of the plastic fixtures, riding securely through the machine.

The plastic fixtures for different housings are made at the plant. An actual switch housing is used as the mold for each fixture. A steel stud to mount the fixture on the spindle extension is put in place before the liquid plastic is poured. The types of shapes involved would be costly to fashion by conventional tooling methods, but the plastic tooling method has meant production with economical costs.

End result of the entire effort is a system which capitalizes on the fast, efficient spraying capabilities of an automatic spraying machine to turn out volume quantities of switch housings on a quality basis at low cost.

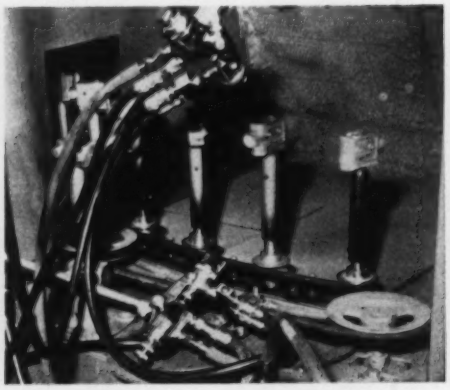


Fig. 2—Rotation of spindles carrying the parts to be painted is effected by means of a belt which engages a wheel on each spindle.

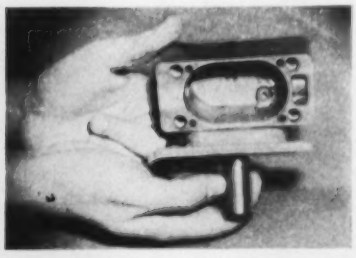


Fig. 3—Fixtures to accommodate different shapes of workpieces are made by pouring plastic into actual parts serving as molds.

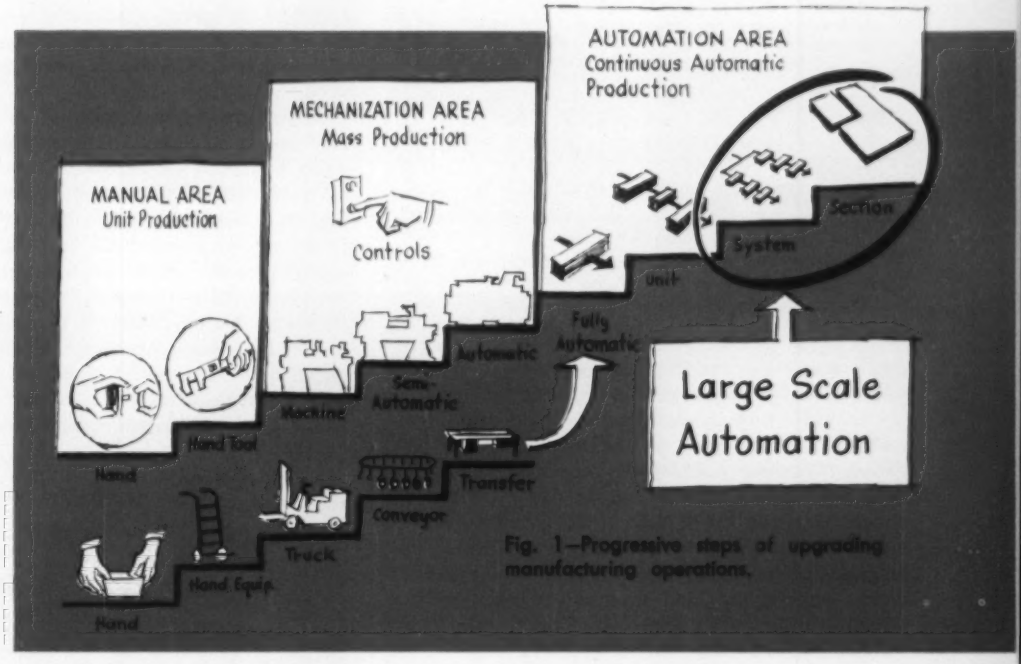


Fig. 1—Progressive steps of upgrading manufacturing operations.

DEVELOPING LARGE SCALE AUTOMATION

By P. H. ALSPACH
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Equipment Development Laboratories
General Electric Co.
Schenectady, N. Y.

Large-scale or full plant automation has tremendous possibilities but requires considerations seldom found in conventional production. What are the overall aspects, the engineering problems and management requirements? Today, automation technology has reached the stage where realistic results are readily attainable but only when the basic prerequisites are recognized and considered.

THERE are many approaches that may be taken in developing large-scale automation and seldom do we find the best approach immediately. A classic example is the correct way for a man to win the affections of a young lady. Often, the seemingly obvious way doesn't get the desired results. Surprising as it may appear, a more direct method, in many cases, is the approach that pays off a small investment with a big return.

So it is with large-scale automation. The approach must be based upon careful consideration of *all* the functions involved in a business—marketing, engineering, manufacturing, finance, and personnel—in order to bring about a successful and profitable experience.

But what is large-scale automation? Let's look at the progressive steps to automation and see where large-scale automation might fall. It will be somewhere between the fully automatic machine and the automatic factory. Think of large-scale automation as several systems of integrated automatic manufacturing equipment. Notice the reference to it as automatic manufacturing equipment and consider that automatic manufacturing equip-

This article is based on a paper presented at the "First Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, October 1956. Mr. Alspach is now Manager-Manufacturing Power Transformer Dept, Pittsfield, Mass.

Fig. 2—Objective of any automation program is to reduce costs.

ment is the *end result* of developing a large-scale automation program in the manufacturing area.

Historically speaking, how has large-scale automation thinking been developing during the past decade? In the late forties, emphasis in automation was in the manufacturing area. Engineers concentrated on the details of designing automatic transfer and material handling equipment: how to pick up a piece, move it into a machine, perform work, move it out, and do it all automatically in the proper controlled sequence. The overall impact on the business was slight, and felt only in the manufacturing function.

In the early fifties, manufacturing men became aware that to further improve their operations, they would have to apply the continuous flow concept to their factories. This called for the integration of their factories—machine tools, facilities, processes, material handling equipment and controls—so that parts and products could be manufactured continuously and automatically.

But this was only the beginning, for the application of the continuous flow concept to the manufacturing function required changes in the design of the parts and products—they would now have to be designed for automatic manufacturing. This would give the product engineering and marketing people an opportunity to standardize and simplify the products and product lines. To accomplish this, the support of management would be necessary as well as the co-operation and assistance of the other functions of the business. Now automation was beginning to have an impact in the engineering, marketing and manufacturing functions.

During the last few years, it has become evident that this "continuous flow" concept could be applied to the *entire* business; not only in the manufacturing area, but also in the offices to the paper working systems, and in the field to the distribution techniques. With this realization, the full impact of automation on the business became evident to management. Professional management began to see in the accomplishments of manufacturing men a challenge to operate an entire business on a continuous, automatic production basis.

Today the challenge of large-scale automation has shifted into the management area. Large scale automation requires that management consider the *whole* business, and not just one or two of the functions. The automatic equipment on the factory floor or in the office is the physical end result of an overall automation program that must, in the future, begin with management's *understanding* and *thinking* in terms of the total concept.

Applying the automation concept—continuous flow—on a large scale to a business that processes materials, such as petroleum, chemical, and foods may require few fundamental changes in thinking. On the other hand, applying the automation concept to a business that manufactures individual assemblies and parts, such as electrical, automotive, and other consumer products will probably require a *major* change in thinking. This change in thinking must start at the *top* with management to be successful, because the basis of the automation concept is thinking in terms of the whole business instead of its component bits and pieces. This is a range only management can encompass.

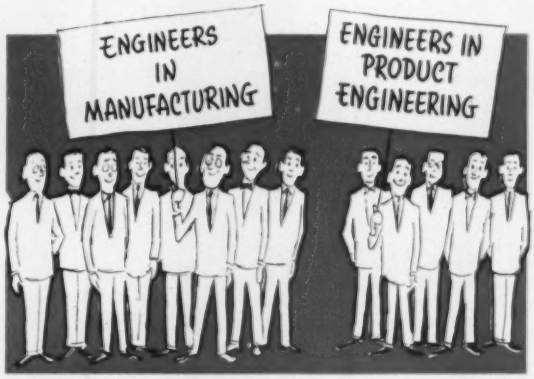


Fig. 3—Increased technical content of manufacturing has prompted many companies to establish manufacturing engineering groups.

▶ Management Function

By 1966, the gross national product may well reach between five and six hundred billion dollars. This would represent a more than forty percent increase in the next ten years. During this same period the labor force is expected to increase by only fourteen percent. For a business to be competitive and to obtain a fair share of this increased market during the years ahead, its management *must* have the vision to be actively engaged *now* in long-range planning.

Long-range planning will require a detailed study of such aspects of the business, as volume, profitability, overhead rates, and distribution costs for each product line and each product in the lines. During the business study, certain immediate changes will become evident that will result in substantial savings or improvements even on a short-range basis. These changes would permit management to gain experience with new procedures and methods, such as going to existing automatic accounting equipment, or applying exist-

ing automatic equipment in the manufacturing area. These improvements will give immediate aid to the business, but it must be clearly understood that they do not and cannot take the place of a sound long-range program and its proper execution.

This long-range planning calls for the management group to take a look at the business five, ten, fifteen, or even twenty years from now and to see what direction it should be going in order to achieve the business objectives. It may result in a revision of some of the basic business objectives. Such things as product lines, accounting and cost methods, manufacturing equipment and plant facilities, distribution system, personnel training programs, and even the business organization and management functions should be carefully scrutinized. Some, or perhaps all of these, may have to be altered to accomplish the long-range business objectives. This may be a lot different from what management has been doing in the past; but in the future, with a rapidly changing economic picture, every business—to be successful—will have to have long-range plans.

This will inevitably lead the professional management team to consider automation. They will want to consider what the continuous automatic production concept can mean to their business today and during the years ahead. The immediate objective of an automation program is to reduce costs through increased productivity and improved quality, but there are additional benefits. Automation will result in more efficient and better management of the entire business through the integration of men, material, and machines in all functions—management, marketing, engineering, finance, manufacturing, and personnel.

In order to apply automation today, two prerequisites must be fulfilled. First, management must "get religion;" that is to say, it must *understand* and believe in the "continuous automatic production" concept. Second, management must *want* to automate. Management must have a real desire to automate and be enthusiastic about it.

With these two prerequisites fulfilled, management is ready to begin planning for automation.

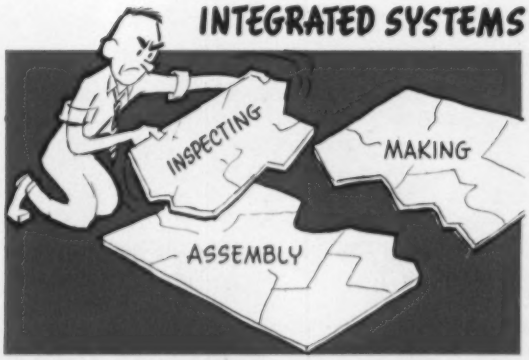


Fig. 4—After experience with automatic equipment has been gained, integrated systems are considered instead of only individual machine requirements.

Fig. 5—Work done by the product engineering group determines to a large extent the degree of economical automation in the factory.

As the first step, after the short and long-range plans for the business have been established, management must appraise *its own function* in the total business. It is up to the management group to provide the proper climate, attitude, and leadership for the business. They must recognize that as our economy increases in size and becomes more complex, so do our businesses and the duties of management.

The professional manager may have the same kind of problems today as he had before, but now they are broader in scope, more complex, and must be resolved in a much shorter period of time. We are having more significant changes in one year now than took place during five years at the turn of the century.

This points out the need for management to take a broader view of the business to become more proficient in the use of its skills, knowledge, and vision—and to be able to make decisions in a shorter period of time with greater accuracy. To do this, management must be continually studying, practicing, and training so that it will be ready and able to handle the complex problems with the necessary speed.

As there is obsolescence of equipment with the coming of automation, so can there be obsolescence of management—management people who are not adequately trained or do not have the vision to handle increasingly complex problems with dispatch.

Having appraised itself, management must look at the other functions—manufacturing, engineering, marketing, financial and personnel relations—and require them to make a creative contribution to achieve the objectives of a large-scale automation program for the business.

▸ Manufacturing Function

Consider the manufacturing function. This is where automation had its beginning and where the concept was formed. Due to the increased use of automatic equipment, controls, processes and new methods, the technical content of the manufacturing area has been increasing rapidly. A large number of businesses have recognized this fact and have established a manufacturing engineering group in the manufacturing function.

In some organizations, the manufacturing engineering function is as large as, or larger than,

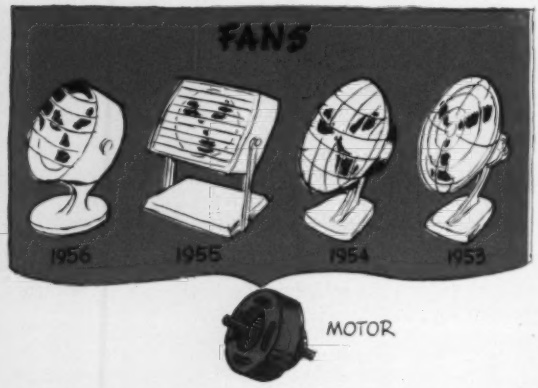


Fig. 6—Manufacturing economies are realized when the motor of an electric fan remains the same for several years while the exterior appearance may change every year.

the product engineering function. It is responsible for the planning and engineering of the manufacturing facilities and the automatic equipment systems.

In doing this planning, manufacturing engineers require a manufacturing development activity to work on new methods, processes, and equipment with the product development engineers. This makes it possible for the manufacturing engineer and product engineer to develop product, facilities, equipment, and processes *together* so that maximum economies can be had. This is a different approach from that taken not too many years ago when, except for a few instances, product engineering would give manufacturing people the design of a product and then expect them to tool up and build it in the most efficient and economical manner. Management has recognized that this just can't be done. If optimum results are to be obtained, the manufacturing facilities *and* the product must be engineered together.

Before leaving the manufacturing function, a few specific points in the automatic equipment field as related to automation are in order.

First, don't be overly ambitious and "bite off more than you can chew." If the business is just starting to use automatic equipment, begin small and tackle the project that your business has the knowledge and ability to support. After experience has been gained, the large-scale equipment programs will come easier.

Second, a great deal of time can be gained and money saved by using standard proved components and equipment wherever possible. Almost every kind of device imaginable has already been engineered and developed into standard products. Incorporate as many of these standard components into the design of your equipment as possible. They will do a better job, simpler and for less money.

Third, take the semiautomatic approach wherever possible. Try to accomplish 90 percent of the savings with only 30 percent of the dollars. Use operators to perform the complicated operations and automate the simple operations first. Then, after more experience has been gained, tackle the more complicated operations. By then, though, through working with product engineering, the complicated operation will be designed out, or a new, simpler process will have been found.

Fourth, keep the manufacturing equipment simple. This is a real art. It makes equipment easier to build, service, and maintain, besides costing much less. Most automatic equipment we know about has been simplified and had parts removed during the building stages or after it has been in operation. Simplification of equipment, during design, is a real challenge.

And, *fifth,* take the time to get the equipment running properly before it goes into production. No special automatic equipment we know of—even though it performed properly during tryout—went into production without some trouble. To minimize these troubles you must be willing to have the vendors take the time to develop the equipment. Then bring the equipment into your own plant and eliminate the remaining "bugs" with your own people and train your operators and maintenance personnel. It takes time and money to get special automatic equipment, and it takes trained people to keep them running.

So much for automatic equipment, but remember that the results of an automation program are only achieved when the automatic equipment is running in production day in and day out.

▶ Engineering Function

Next, let us look at the product engineering area, and see how the degree of automation in the manufacturing area is based to a large extent upon how well these engineers design the product for automatic manufacturing. The keys to large-scale automation actually rest in the product engineering group, for through standardization and simplification of the product designed, they determine, to a large extent, the degree of automation in the factory that is possible from an economical standpoint.

By working with the marketing people, the product engineers must be able to come up with the least number of basic models within a product line, and also to devise ways of making changes to the products, such as adding distinguishing characteristics at the end of the production line. They must work with the manufacturing people to obtain the best manufacturing process and still retain all of the product's functions. The manufacturing process is determined when the engineering designer puts on paper the lines for the part.

As our factories become more automatic and a greater investment is made in integrated manufacturing equipment, there will be obvious economic pressures to hold, for as long as possible, the basic design of the product (such as the motor of an electric fan) within the limits of the manufacturing equipment. The basic design of a fan motor and the manufacturing equipment may remain the same for several years, while the exterior appearance of the fan may change every year.

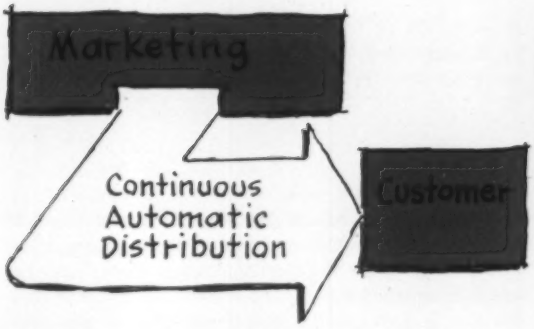


Fig. 7—Automation provides a real challenge to the marketing area.

Fig. 8—Areas of the marketing function will receive increased emphasis in the automation era.

Product engineers must remember that standardization is one of the keys to economical automation. Through standardization, low-volume parts may be used on common components, thus providing the increased volume necessary for automation. But this is only the beginning, for through standardization, fewer basic models may result. With fewer models of a particular item, running out of stock in marketing will be less likely. This should mean greater customer satisfaction and convenience.

Standardization offers the most hopeful solution whereby the marketing demands during the next decade can be fulfilled; yet businesses continually underestimate what standardization can do for for the individual and the industry as a whole.

Next to standardization, probably the most important factor affecting automation is simplification—simplification of product design. Through simplification, many manual operations may be designed out of the product and at the same time the product can be designed for automatic manufacturing techniques.

New industries, like television, that do not have tradition to overcome, are encouraging their engineers to design more and more for automation and particularly automatic assembly. An example of this is designing the placement of electronic components, such as tubes, capacitors, and resistors on an incremental basis. This permits more economical design of products through automatic coding methods and the elimination of drawings, which in turn makes possible economies in manufacturing through the use of programmed automatic equipment.

▶ Marketing Function

Now, let us look at the marketing function and see what its contribution to large-scale automation of the business will be. The marketing function will have to be able to predict, find, and maintain the stable and expanding markets which automation requires, and at the same time develop a new distribution system. To do this, the marketing people will want to learn what automation is doing in the engineering and manufacturing areas. They will also want to understand how products are engineered for automatic manufacturing and how they are processed through the automatic equipment in the factory. With this background, they will appreciate what is required of their function to extend the continuous automatic production concept from the factory to the customer.

This means "continuous automatic distribution," and it's a real challenge to the marketing area. It requires the integration of distribution opera-

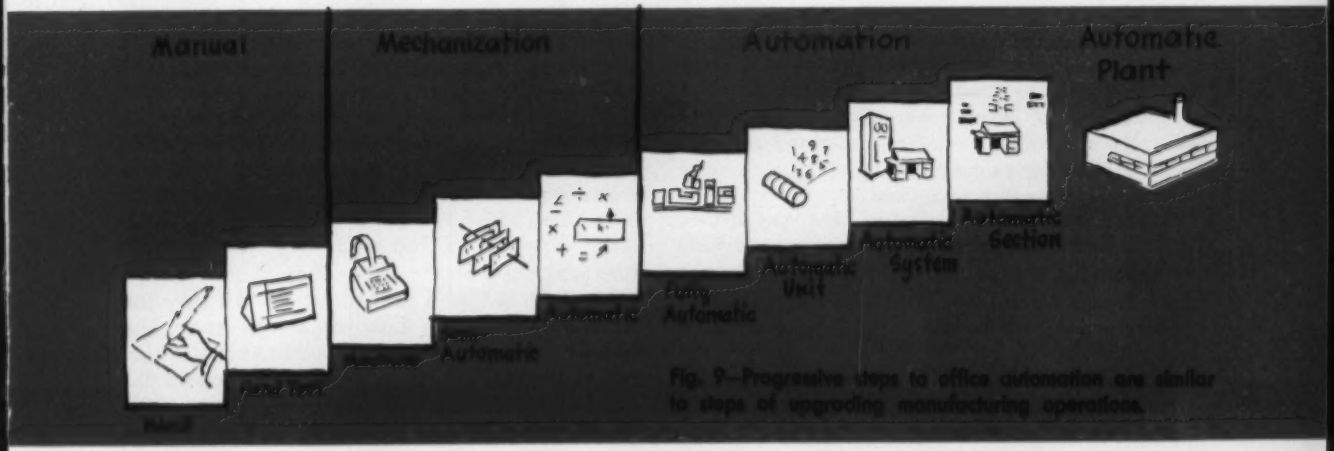


Fig. 9—Progressive steps to office automation are similar to steps of upgrading manufacturing operations.

tions so that the product will move from the factory to the customer in the shortest time and at the lowest cost.

The marketing man will have to sell the customer the advantages that automation will bring to him, such as improved quality of product at lower cost. In addition to that, there will be greater availability of parts and service, because if the part or product is a standard item the dealer is less likely to be out of stock. The customer will also have to be sold on the advantages of buying a standard basic product with distinguishing characteristics instead of a special product. This, in a great many instances, will require a fresh approach from the marketing standpoint.

Three additional areas in the marketing function that will receive increased emphasis by management in the automation era will be: product planning, long-range market forecasting, and market research. The ability of the marketing people to predict the life of a product design and the yearly design changes required will become more important. Also the need for accurately forecasting the market level for a product design will become more important with automation. Management's decisions, based on marketing forecasts, will be of increased importance and will play a large role in determining the profitability of a business through automation.

▶ Financial Function

Next, let us look at the financial function and see the important role it plays in developing large-scale automation. The financial people assist in determining the economies of purchasing or leasing automatic equipment in the factory, office and distribution system. Their role does not end there, for in most businesses they must also provide the necessary funds.

The financial people also share the responsibility with the other functions for automation of the office and the paper work systems within the business. New office machinery available today offers many opportunities for the simplification of routine, clerical, and accounting procedure. Office procedures must be revised to fit and exploit the available equipment on the market today. In certain cases, it will call for the development of a modern common-language medium to integrate these new automatic machines. There is a great deal that can be done through elimination and simplification of paper work. Once this has been done, the remaining necessary paper work should be handled as far as economically feasible on automatic data processing equipment.

Management must remember that the office, like the factory, requires a certain volume to justify automatic equipment. If the volume is not there, then a careful look should be taken at using semi-automatic equipment in the mechanization area.

Here we see the progressive steps to automation of the office. These not only apply to the financial group, but to all office functions of the business. Automation of the office function makes available to management, in a shorter period of time and more accurately, the reports and information necessary to control a business.

▶ Personnel

Next, let us look at the personnel area and the urgent need to train people—to upgrade their skills. In many industries today there are not enough adequately trained people to run and service the new automatic equipment that is installed. Here we see the concentration of people in the manual and mechanization areas today. With the increased use of automatic equipment with its electric, pneumatic, and hydraulic controls, the manufacturing people should start as soon as possible to plan to upgrade the skills of those who will be responsible for operating and maintaining this equipment. The importance of recognizing the need for upgrading the skills of the people and helping them do it can often mean the difference between success or failure of an automatic equipment program.

In order for a program to succeed though, it requires the full co-operation of everyone in the plant. This means that everyone must understand the automation program. It is important that management take the time to explain it to the people and keep them informed so that they will know what is planned and can offer suggestions.

The personal benefits should not be overlooked either, such as making clear that the heavy repetitive work will be done more and more automatically, and that the work will be safer and more interesting. Automation lets people use their higher skills. The work they do will be more rewarding in its variety and in the challenge that each task presents.

In developing large-scale automation, it is important to remember that all functions of a business today can be automated. The question is not whether they *can* be automated, but rather *"how much"* and *"how soon"* should they be automated. It's up to management—professional management with vision, enthusiasm, and imagination—to apply the continuous flow concept to their business. They must determine the degree of automation in each function that their business requires and can support economically. They must develop an integrated step-by-step program and see that it is properly carried out. Management must also determine what changes will be made, whether in management thinking, product design, personnel development, manufacturing processes, marketing techniques, or office procedures. Some, or perhaps all of these may have to be altered in order to develop a successful large-scale automation program.

As the Red Queen said to Alice when they met in Wonderland, "You must run as fast as you can to keep up, and you must run twice as fast as you can to get ahead." A large-scale automation program offers industry one way to run twice as fast as it could before.

PROCESS CONTROL

By JAMES R. WALKER
Director of Research, Gemco Electric Co., Detroit, Mich.

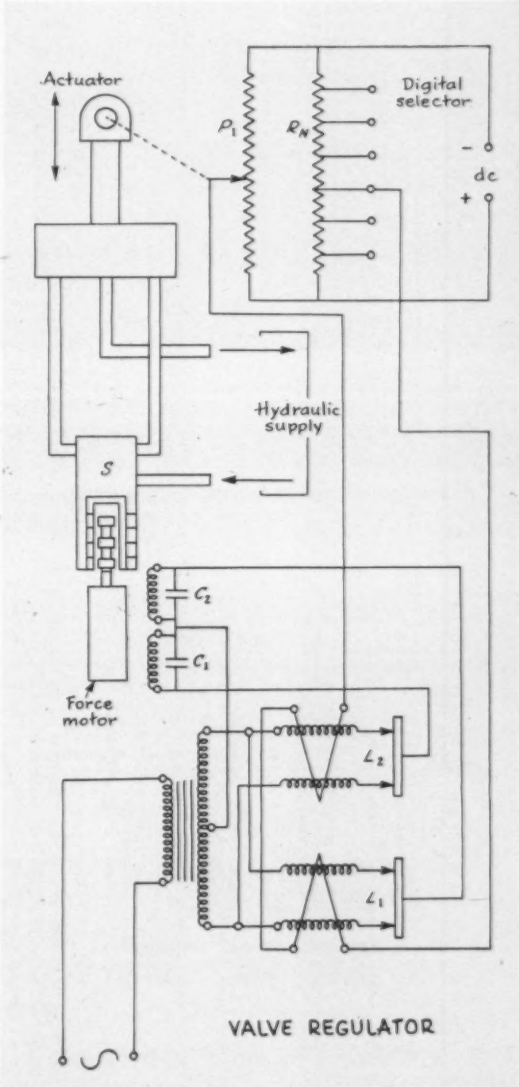
NUMEROUS industrial process applications require the control of large amounts of electrical power. The magnetic amplifier, a type of saturable reactor, has proved its worth in the process field in this respect. With magnetic amplifiers, control can be obtained with only small amounts of signal power; the size of control equipment can be reduced; and control means can be conveniently located with respect to the process under control. From an operating standpoint, magnetic amplifier circuits are superior in that the number of moving electrical contacts in a circuit is reduced with an attendant increase in trouble-free life. In processes where gradual or stepless control is desirable, such as in heating applications requiring close and accurate temperature regulation, the special characteristics of the magnetic amplifier assume added importance. In this fifth of a series of six articles devoted to the application of magnetic amplifiers, three process regulator circuits designed to take advantage of the attributes of the magnetic amplifier are discussed.

Valve Regulator

Feedback control systems employing proportional type hydraulic valves are used for many types of positioning applications such as position control of boring and drilling heads on machine tools. In such applications, an amplifier capable of providing polarity reversible current proportional in amplitude to suitable system error signals is necessary to actuate force motor coils within the valve, which in turn accomplish appropriate positioning of the valve spools. The illustration shows a circuit diagram for a transverse position control utilizing a proportional hydraulic valve actuated by a push-pull or balanced type magnetic amplifier.

It may be noted that each section of the force motor control coil acts as a load member for each half of a center-tap connected push-pull magnetic amplifier. The error control signal for this amplifier is obtained from a bridge composed of position feedback potentiometer P_1 and digital position selector R_n.

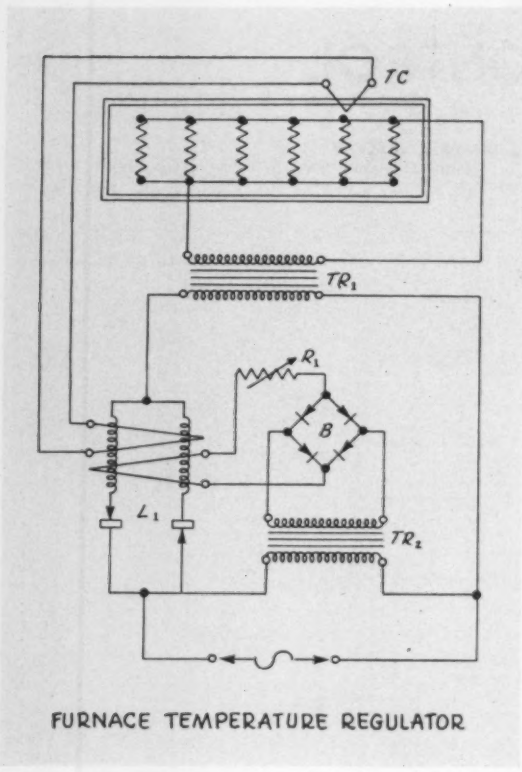
For the purpose of explanation assume initially that the bridge is balanced and it is then desired to move the fixture to a new position. This is accomplished by moving the digital selector to the desired setting whereupon the signal bridge becomes unbalanced. The polarity of the signal current into amplifiers L_1 and L_2 is such as to result in an increase of the current out of one side and a decrease of that in the opposite side. Accordingly the force motor moves control valve spool S so that the hydraulic actuator is repositioned which in turn moves the potentiometer slider P_1 and thus balances the digital signal bridge.



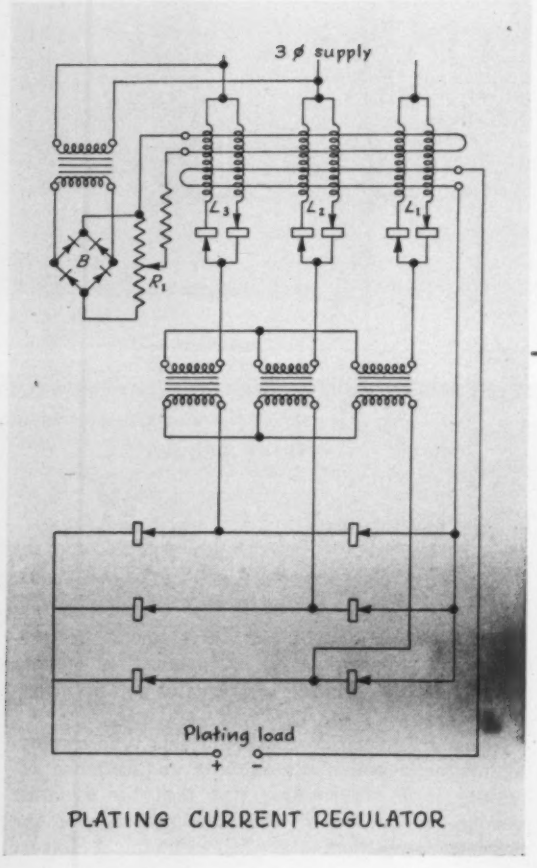
VALVE REGULATOR

Small oscillations of the valve spool are prevented by suppressing ac components of current existing across each half of the valve coil by means of condensers C_1 and C_2.

Although a position control of this type employing magnetic amplifiers exhibits unquestioned reliability it is nevertheless true that the dynamic response is limited by the slow response of the magnetic amplifiers. If the mechanical fixture



FURNACE TEMPERATURE REGULATOR



PLATING CURRENT REGULATOR

and hydraulic ram of the control system have a natural frequency above 20 cycles per second then the limiting response of the system will result from that of the magnetic amplifier which is close to 5 cycles per second for a 60-cycle supply frequency. This response may be improved by utilizing magnetic amplifiers on a 180 cycle supply. In this case the servo bandwidth may be extended to about 8.5 cycles per second.

Furnace Temperature Regulator

Feedback control of oven temperature has been accomplished in the past principally by the use of thermocouples in combination with relays. The relays utilized with such systems have been caused to step-vary a low resistance or reactance unit in order to appropriately vary the furnace power supply in maintaining a constant furnace temperature. Although systems of this type are useful over a narrow range of temperatures there is little possibility of set-point temperature variation over the wide range required for many commercial applications. A further undesirable feature of these relay systems are the contactors, especially thermostatically controlled contactors which frequently must function in an atmosphere that decidedly limits contact life.

Relays for *On-Off* control or regulation of furnace temperature may be replaced by a saturable reactor in accordance with the circuit shown in the illustration. The saturable reactor and associated rectifiers (identified as L_1) provide primary current for heater transformer TR_1. The control of L_1 is accomplished by a comparison of the ampere turns due to a thermocouple TC with the ampere turns arising from setpoint resistance R_1 and the reference potential derived from bridge rectifier B.

Action of the reactor is such that preponderantly high TC ampere turns will cause a reduction in saturation of L_1 while the opposite will be the case if the set-point ampere turns is excessive. Controls of this type may be used to control furnaces requiring up to 100 kw primary power.

Plating Current Regulator

A plating current regulator employing the same general principles as that for a furnace regulator may be used to replace the troublesome tap switches so often employed in the past for plating current control.

As shown in the illustration, a three-phase saturable reactor supplies regulated current to a three-phase bank of transformers and secondary connected rectifiers. The regulating action of the reactor is determined by the relative magnitude of reference ampere turns R_1 and current feedback ampere turns obtained directly from the plating load current. An increase in plating current will result in a reduction of reactor saturation and thus a return of current to its preset value. The maximum power which may be controlled economically for this process is on the order of 100 kw.

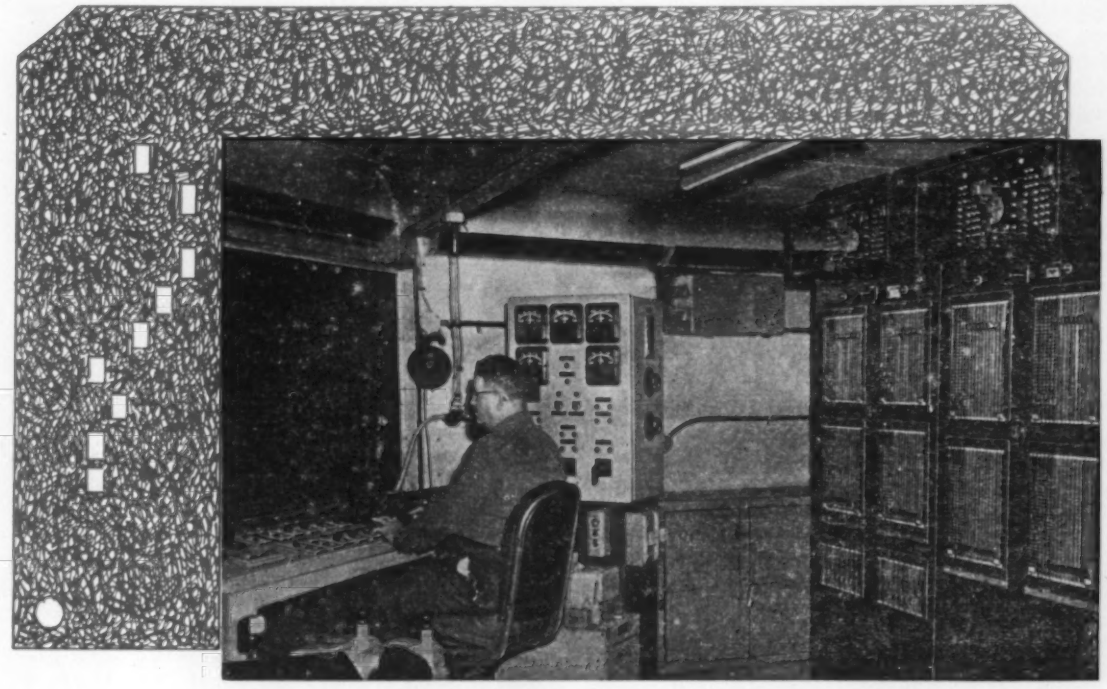


Fig. 1—Use of two schedule panels provides quick change-over of schedules. One can be set up while other is in use. The second panel is cut in by transfer switch under operator's control.

REVERSING MILL DEVELOPMENTS LEADING TO

PUNCHED CARD ROLL POSITIONING

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The effect of an increasingly complex technology is readily apparent where human control of equipment is a part of the overall control scheme. The point is soon reached where practical considerations dictate that the human be given assistance. In industry the results can be gratifying—improved production, quality and equipment performance.

CONSIDERATION of the relatively complex problems facing the operators of major installations in the basic metals industries very early led to interest in automatic control devices. As a result, today in both the ferrous and nonferrous industries there can be found numerous examples of proved control systems developed to lighten the operator's task and to obtain increased production of an improved product. Such is the system which provides for pushbutton control of the important auxiliary drives of various types of reversing mills.

As shown in the accompanying box, reversing mills vary in complexities so far as the number and types of different rolls and work handling

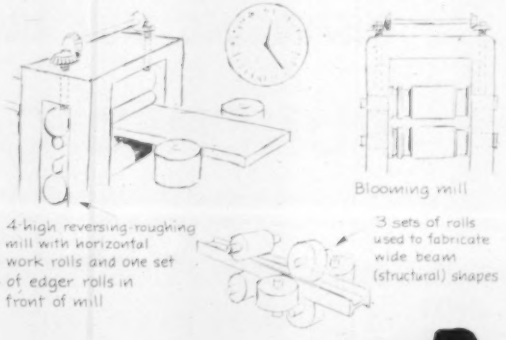
devices are concerned. The operation of a reversing mill is under the control of an operator stationed in a pulpit overlooking the production area. Basically, the operator directs metal through the mill in successive passes, adjusting the various roll spacings (draft) prior to each pass so as to obtain in the final pass whatever sectional dimensions are desired in the metal. As an example, in a semicontinuous plate mill the operator might control: (1) main mill and vertical edger drives; (2) screwdown drives; (3) in-out movement of vertical edgers; (4) in-out movement of side guides; (5) front and back worktables; (6) approach and delivery tables; and (7) water sprays.

The complexities of rolling wide beam structural sections, such as an H-beam, are increased due to the need for forming the steel by three separate pairs of rolls, each pair being subject to individual adjustment on every pass through the mill.

But complexity is not the only consideration; the quality of a rolled metal product is influenced greatly by the manner in which it is rolled. All other factors being equal, a consistent control of the draft for each pass will give a product superior to that where no definite rolling schedule is followed. Therefore, an ideal rolling schedule consists of a certain number of passes with each pass calling for specific spacing of the rolls. Under manual control, the mill operator must memorize the numerous draft positions—a potential source of error that can be readily compounded by the urge to produce high tonnage since this often precludes an exact setting on each pass.

In short, all of the various considerations point to the desirability of providing the operator with automatic control aids. These, then, are the considerations that led, in 1936, to the installation of the first EC&M automatic positioning screwdown control on a four-high reversing roughing stand of a 100-inch semicontinuous plate mill. The operator of this mill is responsible for the seven operations previously referred to as an example in a semicontinuous plate mill. But there is a difference; under automatic positioning control, the movements of screwdown, vertical edger and side guides occur simultaneously at the touch of a pushbutton. More specifically, the system provides a step by step regulation of roll adjustment in accordance with a preset schedule; each step is initiated by the operator by pushbutton. The operator controls the reversal of the main rolls and edger rolls with a foot master switch; front and back worktables are controlled from hand operated switches. The operator has ample time to operate the water sprays with pushbuttons and approach and delivery tables from hand master switches. This first installation made about 20 years ago is still operating efficiently under the original con-

Reversing mills are used in the rolling of metal into strip, plate, slabs, billets, blooms, and structural shapes. Control requirements depend on the type and form of product being rolled. The main mill motor rotates the work rolls and is usually controlled by a foot master switch located in the operator's pulpit. The upper roll is counterbalanced and is raised or lowered by screws mounted in the top of the mill housing. These screws are driven by one or two screwdown motors mounted on top of the mill. The operator is provided with means of controlling these motors in obtaining various draft positions. Front and back tables which propel the metal into and from the mill are of the reversing type and are also operated from the pulpit by master switches. On reversing-roughing mills, vertical edging rolls and side guides are used. These are likewise operated from the pulpit. Both must be moved in and out to provide clearance on alternate passes. In rolling structural shapes, three pairs of rolls are subject to individual control. Blooming mills, in addition to the screwdown and worktable drives, have motor driven side guards and manipulator fingers. Manipulator fingers may be mounted on both front and back side guards. The side guards move the ingot from the flat or bullhead pass to the edging passes and guide it to the proper section of the rolls. The manipulator fingers are used to turn the ingot 90 degrees for the edging passes and to return it to the bullhead pass. As a guide to the operator a screwdown indicator, attached to the mill or mounted in the pulpit, shows the roll opening on a dial. All mills except large blooming mills can be operated by one man. From a control standpoint then, the operator is


Blooming mill
4-high reversing-roughing mill with horizontal work rolls and one set of edger rolls in front of mill
3 sets of rolls used to fabricate wide beam (structural) shapes

faced with the difficult problem of co-ordinating many different actions in obtaining optimum performance from an investment valued in millions of dollars.

Fig. 2—Schedule panel of earliest installation was preset by interconnecting various receptacles with jumper cords to obtain main and vernier settings for desired passes.

trol equipment. Although many improvements have been made, the basic design of the automatic positioning control has proved very successful.

Scheduling Roll Positions

Part of an automatic positioning control system consists of a schedule panel that serves as a central control point at which one or more complete rolling schedules may be preset, *Fig.* 1. This schedule panel must provide for complete flexibility in presetting a schedule. As will be explained later, the system provides for a main adjustment and a vernier adjustment in controlling the direction and final positioning of the screwdown motors for a given pass. This is reflected in the schedule panel which provides two distinct schedule boards —one for a main increment and one for a vernier increment setting for each pass in the rolling schedule.

In the earliest schedule panels, the possible variables of a given installation were represented by groups of receptacles designed to receive plugs. The desired schedule was preset by connecting various receptacles by jumper cords, *Fig.* 2. The network (it was necessary to locate both ends of two cords which required four connections per pass per schedule) could be rather complicated, and the setup procedure was not as rapid as could be desired nor was it easy to check for accuracy.

The schedule panel was improved considerably by a system in which it was necessary to locate only two plugs (one main and one vernier adjustment) for each pass per schedule. This latter improvement set the stage for the modern form of the panel equipment—slider contact panels, *Fig.* 3.

Recently made available is the punched card system in which a card punched with holes represents a complete rolling schedule, *Fig.* 4. The cards are direct-reading for easy preparation and simplicity in interpretation. Since neither coding nor decoding is required, the number of relays used by the system is considerably reduced. The cards are plastic and have scales or markings in inches to show possible roll positions; pass identification is readily ascertainable. The card also contains limited provisions for control of auxiliary devices or functions by the punch sensing equipment. It should be noted that punched cards provide a quicker way of changing schedules. Desired roll adjustment for each pass is programed by the cards but roll adjustment is actually initiated manually by pushbutton for each pass.

Sensing Roll Positions

An important part of the basic design of the original system which has proved itself through the years involves the roll position—indicating means which is connected to the screwdown drive. An adjustable potentiometer driven by the screwdown provides a signal voltage to indicate the position of the rolls. To permit remote mounting of the potentiometer unit in the pulpit or control room, two small Synchro-tie motors function as an electrical coupling, one geared to the screwdown and the other to the potentiometer unit.

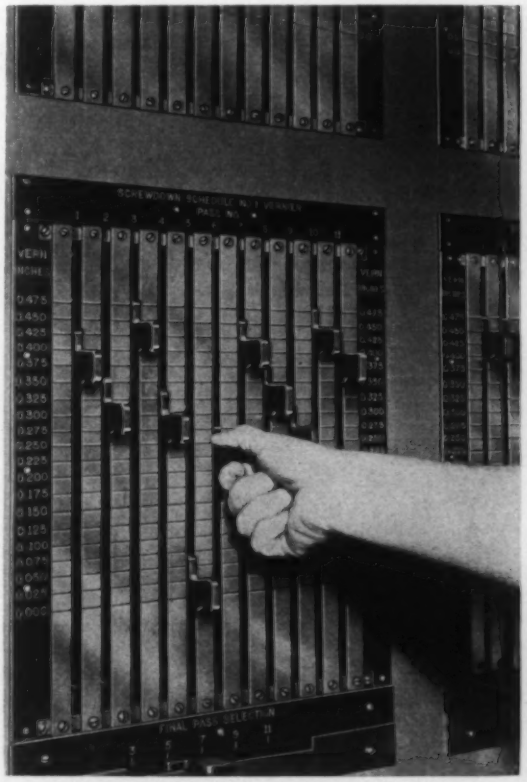


Fig. 3—Modern schedule panel consists of contact positions which are preset by moving sliders to obtain desired roll positions.

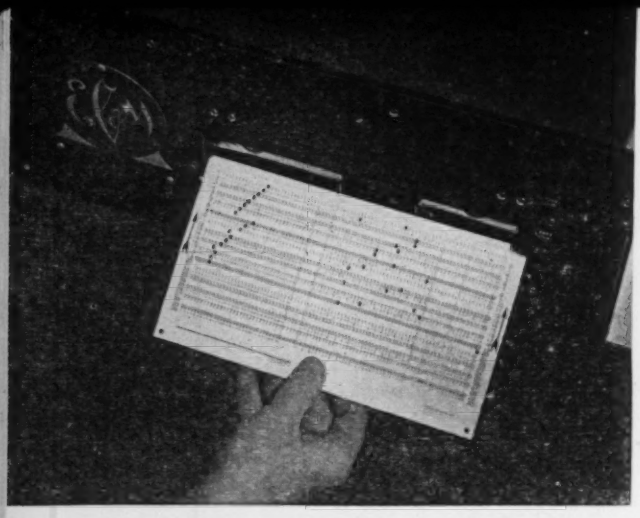


Fig. 4—Punched card reader is used for same purposes as schedule panel. A plastic card is punched with complete information for a given schedule. The card also contains spaces for control of auxiliary items if desired.

This latter unit consists of two face plate switches, a setup motor, a cam switch unit, and the receiver Synchro-tie motor. These elements are mechanically connected through a gear train which includes differential gearing, *Fig.* 5.

The main and vernier adjustments have been previously referred to; the two face plate switches are part of the adjustment circuit. Identical resistors are connected in series across each contact of the switches to form one main and one vernier potentiometer. Up to 40 contacts are available on each face plate. The design of the system is such that each main contact represents a roll movement equivalent to the complete vernier potentiometer. Thus, a combination of main and vernier potentiometers permits up to 1600 increments for roll positions from only two 12-inch diameter face plate switches. *Figs.* 6 and 7 illustrate the main features of the differential potentiometer assembly and its associated circuits.

Circuit Functions

Certain facts will help in interpreting the diagrams: Only the main schedule panel and face plate switch, through the cam switch unit, control the position of the screwdown motor. The screwdown motors are started by pushbutton and the final slowdown, dynamic braking and the application of the magnetic brake are controlled by the contacts of the cam limit switch. The vernier schedule panel controls the final position of the setup motor through the vernier rheostat. Rotation of the setup motor is reflected as a controlled displacement of the main rheostat arm. A stepping relay circuit and the gear train in the differential assembly are designed so that as soon as the screwdown motors stop, after having made a desired adjustment, the vernier contact arm is automatically positioned by the setup motor for the next roll setting as called for by the vernier schedule panel or punched card. Thus setting is made while metal is passing through the mill in accordance with the previous setting. The operation is fast because only the vernier arm moves, and it never rotates more than 300 degrees. When the rolling schedule is completed, the vernier arm is automatically returned to the setting for the first pass of the schedule.

These actions might be considered the highlights of a given cycle: Operator pushes button for a given pass; screwdown motor operates to adjust rolls; screwdown motor is braked to accurate stop through cam switch circuits with main rheostat arm located in center of contact segment; while metal goes through rolls stepping relay sets up necessary circuits for the next pass; setup motor automatically responds to vernier schedule for the next pass and, under control of the vernier face plate switch, displaces main rheostat arm by a fractional increment; and to complete the cycle—operator pushes button for the next pass.

Variety of Settings

The EC&M system of automatic positioning control, with its unique differential drive, provides a wide choice of roll positions because of the large number of different roll settings available.

For four-high, reversing-roughing mills, the control has been most frequently supplied to provide settings in increments of 0.025-inch, with a maximum working range of 20 inches. Where vertical edgers control only the width of the slab, short-stroke limit switches are used to retract the edgers and side guides on alternate passes. Where edge rolling is required for the product, a second automatic schedule provides adjustable roll settings for the edger rolls in one direction and retraction is provided on alternate passes. Edger roll settings have usually been provided in increments of $\frac{1}{8}$-inch with a maximum working range of 100 inches. Five roughing mills with automatic positioning on the edgers are in operation, the first one installed in 1940.

Control for reversing plate mills has been supplied to provide settings in increments of 0.010-inch with a maximum working range of 10 inches. In order to compensate for the spring of the mill when rolling temperatures drop below normal, a temperature-correction adjustment is designed so that the finishing passes can be adjusted in increments of 0.001-inch from the operator's pulpit. Adjustments are made by moving a small dial after readings are taken from a radiation pyrometer.

A reversing hot strip mill with furnace coilers uses increments of 0.1 mm with a working range of 90 mm. A vernier screwdown motor is used to make minute adjustments on the last passes.

On large blooming-slabbing mills with maximum working range up to 65 inches, the control will provide settings in increments as small as 1/16-inch.

Wide beam mills require the simultaneous setting of three sets of screwdown adjustments—for edger,

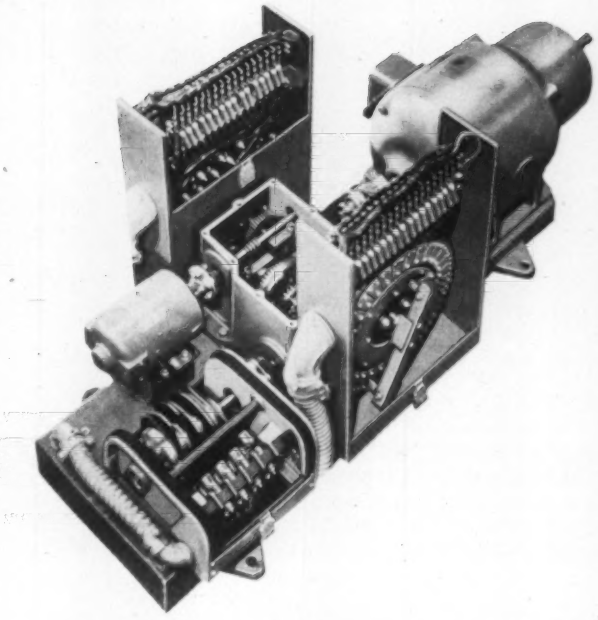


Fig. 5—Differential potentiometer assembly. Main potentiometer is in foreground; vernier is in rear. Receiver Synchro-tie motor is on right, setup motor on left. The elements are tied together through the differential gearing in middle of picture.

for horizontal and for vertical rolls. The graduations furnished for edger and vertical rolls are increments of 0.010-inch but on finishing stands, the horizontal screws have been provided with increments as low as 0.005-inch.

In any of the installations when rolls need replacement, the automatic positioning control is easily adjusted to compensate for changed diameters of the new rolls. The receiver Synchro-tie motor is equipped with a coupling having a vernier adjustment. This adjustment permits resetting the automatic control system to conform to the calipered roll opening.

Since its inception, the many improvements in the automatic control system primarily have been made to increase the speed of roll adjustment. Originally, polarized relays were used to control up or down movements and stopping positions. More recently these operations were controlled by electronic detectors with anticipating electronic relays to control slowdown. This permitted a great increase in operating speeds by reducing the time required to move the rolls and stop accurately on the preset pass settings. Now the use of magnetic amplifiers in slowdown and stopping control circuits provides a greater operating range or smaller increments of adjustment over a given range.

Screwdown Motors

The automatic positioning screwdown control has been applied to motors operated from constant potential and also adjustable voltage power. In most applications, constant potential control gives better results because it permits the use of simple components consisting of series or compound wound motors and series brakes. Screw movements for the average draft usually represent only a few revolutions of the motor which rarely attains full load speed, and these short movements are made faster with series or compound motors and series brakes. The relative moment of inertia is small so that acceleration and stopping is very rapid. To open the mill fast, the load conditions are such that field weakening can be used to attain high speeds. Adjustable voltage control is often selected for large blooming-slabbing mills where the ingot is manipulated to and from edging passes requiring large roll movements either up or down for the next succeeding pass. On these long movements, the application of higher voltage by the adjustable voltage system permits higher motor speeds. On some fast reversing, four-high roughing mills rolling aluminum, the screw pressures produced by the hydraulic counterbalance are very high to prevent slipping between the work rolls and large backup rolls during acceleration and stopping. The power required to drive the screws is consequently very great due to the high friction load. Adjustable voltage control permits higher speeds for these drives with the same size motor.

Manual Operation Possible

Conditions may arise which make it advisable to depart from the automatic rolling schedule and

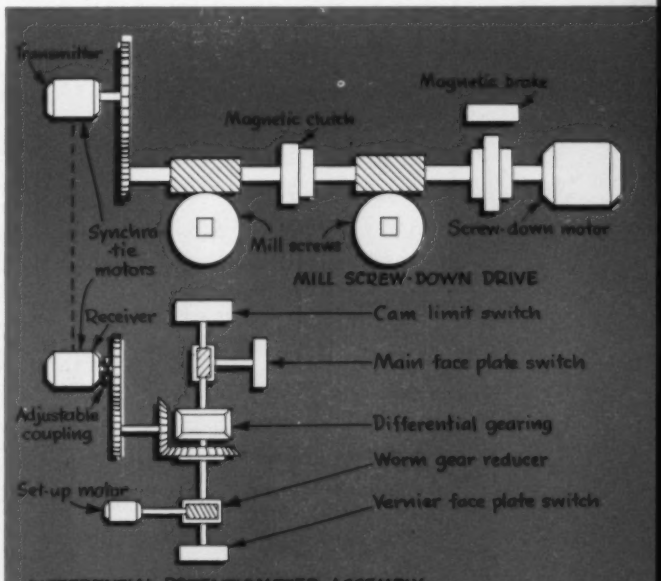


Fig. 6—The mill screwdown drive is electrically coupled to a differential potentiometer assembly located in the pulpit or some convenient point.

instead, manually control the screwdown motors to set drafts. Cold metal or a cobble developing after one or more automatic passes may necessitate completion of the schedule by controlling roll openings manually. Where a mill normally rolls products according to automatic schedules it is possible with manual control to process a single isolated order of unusual dimensions.

To operate manually, the roller merely uses the master switch to drive the rolls up or down, *Fig.* 8. There are no transfer or knife switches to be manipulated. When returning to the automatic system, it is only necessary to center the manual controller in the *Off* position, which re-establishes the operating pushbutton circuit. The positioning switches remain synchronized with the mill because they are coupled to the mill through the Synchro-tie motors. If it is desired to finish roll automatically after a few manual passes, the automatic system is provided with a "setup" pushbutton that advances the automatic system and picks up the next proper pass setting for finishing the rolling under the automatic system. If manual control is used to complete a rolling schedule the automatic system can be re-engaged ready for the first pass of the preset schedule by pressing a pushbutton.

Control by pushbutton has resulted in many economies and a product rolled to more accurate tolerances. Automatic positioning control contributes to faster movement of metal in and out of the mill since the operator is able to concentrate on duties requiring human judgment. The extent to which automatic positioning control aids reversing mill operations perhaps can best be appreciated by reference to the experience of one steel company in beginning operations in a new mill. As there were no other steel mills in the immediate area, rolling mill operators had to be trained. With positioning control, men who had never before operated reversing mills were turning out a saleable product within a few hours.

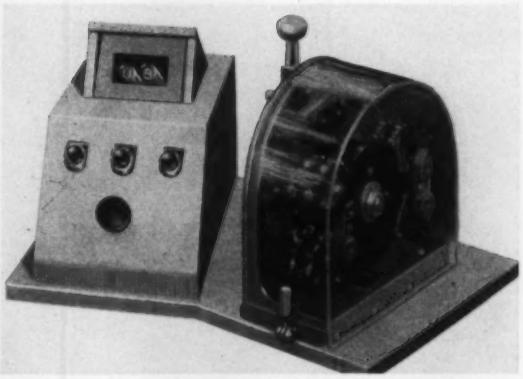
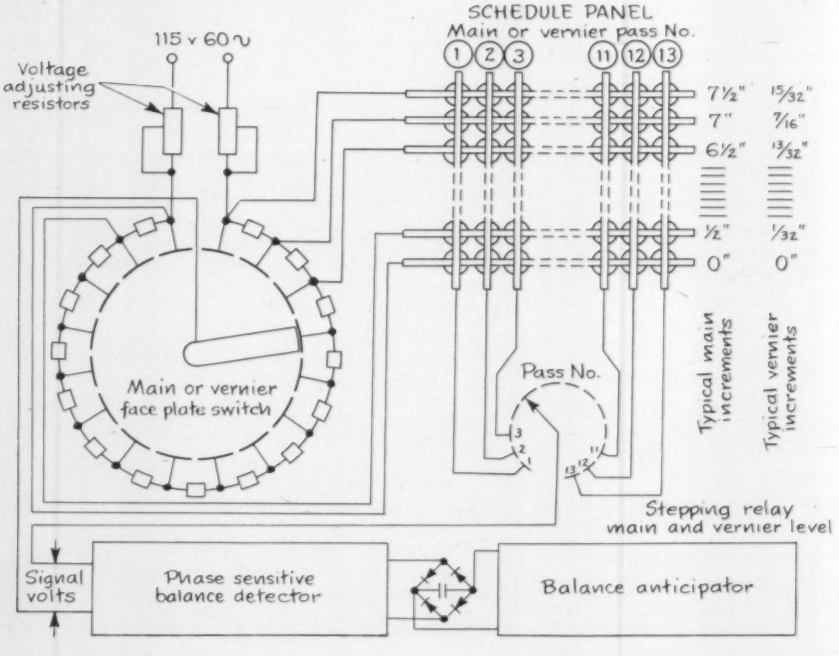
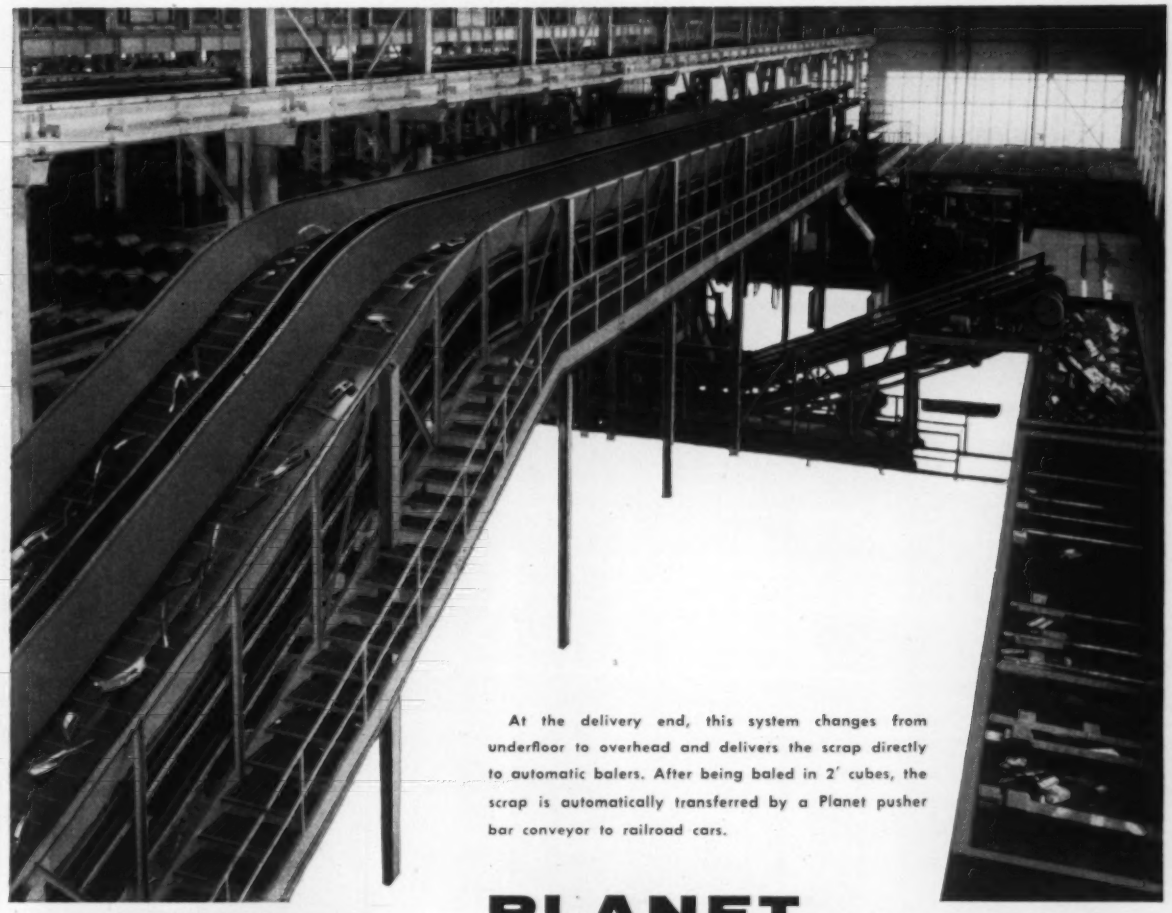


Fig. 8—Speed control switch, right, and pushbutton control for automatic positioning control system. Large operating button that initiates each pass is located below three smaller buttons that provide for different types of adjustment to the automatic system. Digital neon tubes on top of pushbutton controls light up to show pass number.

Fig. 7—Diagram of typical circuit showing relationship of position indicator, schedule panel and main or vernier face plate switch.





At the delivery end, this system changes from underfloor to overhead and delivers the scrap directly to automatic balers. After being baled in 2' cubes, the scrap is automatically transferred by a Planet pusher bar conveyor to railroad cars.

PLANET
ENGINEERED SYSTEM
automatically handles 20 tons of scrap per hour

This Planet apron conveyor, moving through a tunnel under trim presses, automatically delivers to the balers up to 20 tons of loose scrap per hour. A simple clutch-operated auxiliary drive assures continuity of operation.

For a leading automobile plant, Planet recently engineered and installed a 1200 foot system to handle the scrap from trim presses having a combined capacity of over 4000 tons. Because the entire operation is automatic, this scrap handling system saves time and money . . . and baled scrap is worth more, too.

It paid this manufacturer to use Planet's engineering-know-how. If you have a scrap handling problem it will pay you to write or phone today and "PLAN WITH PLANET"

PLANET CORPORATION

1810 SUNSET AVE., LANSING, MICH.

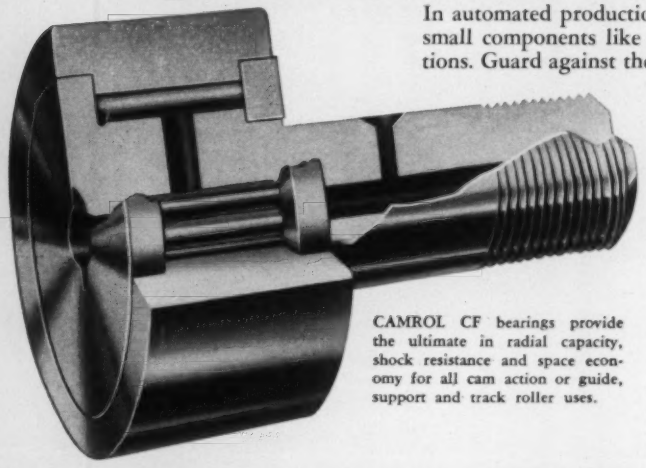
- **ENGINEERED HANDLING SYSTEMS**
- **AUTOMATED EQUIPMENT**
- **FOUNDRY HANDLING SYSTEMS**

65

Circle 577 on Inquiry Card

AUTOMATION TIPS by McGill

CAMROL TRADE MARK bearings ideally suited to anti-friction requirements of automated machinery

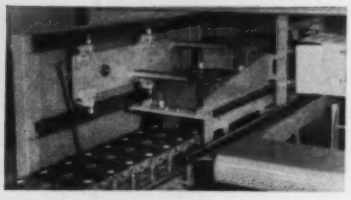


CAMROL CF bearings provide the ultimate in radial capacity, shock resistance and space economy for all cam action or guide, support and track roller uses.

In automated production, even the inefficiency and faulty operation of small components like a cam follower unit can cause costly interruptions. Guard against these failures by specifying CAMROL cam followers. Their quality insures dependability. Their design simplifies lubrication, easily accommodates critical loads and provides low starting and running friction.

Over 20 years of engineering development has gone into the McGill bearing — the first commercial full-type roller bearing cam follower. McGill has employed the advantages of these years of application experience to improve the design and build performance extras into the CAMROL CF, CYR and sealed SCF and SCYR series bearings. All are available in a wide range of standard sizes.

The applications cited below are just a few of the many instances where CAMROL bearings are adding to the dependability of automated machinery.

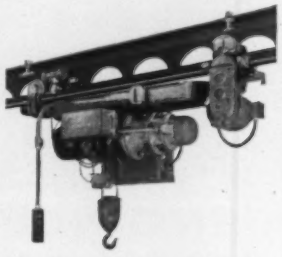


Camrol CF bearings cut power requirements on J. L. Ferguson Co. packaging machines

Used as load-carrying cam followers and as guide rollers in PACKOMATIC packaging machinery, McGill CAMROL CF bearings have brought several desirable advantages to J. L. Ferguson Company in the eight years this firm has relied on CAMROL bearings.

The CAMROL CF bearings eliminate wear by reducing friction. This reduces power requirements and smooths the operation of these machines. The CF bearings are standard, cost less and are more easily applied than previous assemblies.

For trouble-free operation, up to 50 bearings per machine are now used by this company.

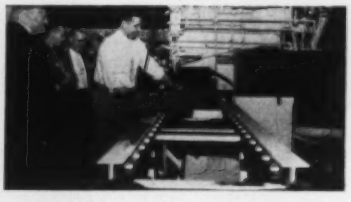


Cleveland Tram Rail guides motor heads on McGILL Camrol Bearings

Motor-driven electric hoist carriers made by the Cleveland Tramrail Division of the Cleveland Crane and Engineering Company, incorporate McGill CAMROL Cam Follower bearings as side guide rollers for the motor head.

Replacing spring loaded friction type bolt or roller units, the CAMROL cam followers provide dependable, free running operation of the carrier assembly and provide simplicity of mounting and lubrication with trouble-free performance.

Bearing performance has been most satisfactory through almost six years of use.



Camrol CF bearings provide friction-free track rollers for automatic mold blower

McGill CAMROL CF rollers are used as track rollers to form a mold conveyor in the Beardsley & Piper MBS-20 Mold Blower. The CAMROL CF bearings replaced built up friction rollers in this application. Although the duty here is rather light and the speeds slow, the cam follower bearing provides less starting and running friction. This helps speed the even flow of work from the machine, which must be fast and automatic. The compact unit, with integral stud, simplifies assembly and lubrication. Availability of a standard bearing is more convenient and less costly.

SEND FOR CATALOG 52-A

Insure performance with McGILL®

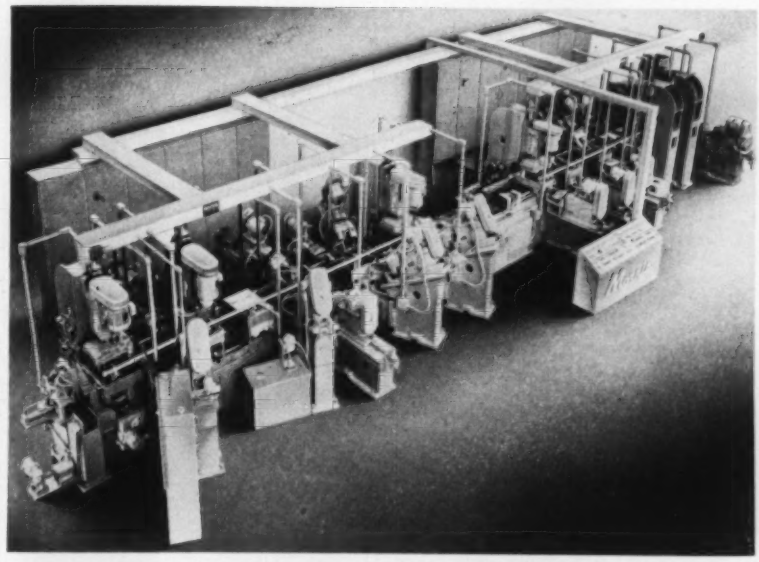
MULTIROL® GUIDEROL® CAMROL
Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

AUTOMATION new equipment

Machines and plant equipment designed for more automatic operations

For detailed information and literature, use card page 17

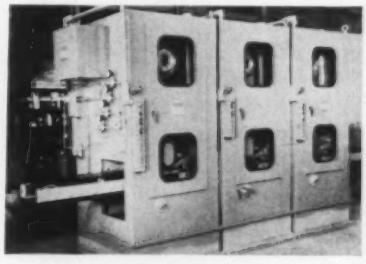


High Speed In-Line Transfer Machine

Designed to produce two and four-barrel carburetor bodies, in-line transfer type high production machine automatically completes one part every 7½ seconds. The machine incorporates Morris standard production units—fourteen #1 Cam-matic, seven #2 Cam-matic and four Air-Oil-Matic drill units. They perform 31 drilling, 19 boring, 10 reaming, 4 gaging, 13 probing and 13 tapping operations.

The machine processes 480 parts per hour, involving 56 stations. Its automatic features include an automatic loading section which checks parts and rejects those in improper position. Precision locator holes are drilled and gaged for accuracy at the first station. Both first and second sections may be operated either individually or as a single unit. Automatic loading and unloading is provided in the center section, where automatic storage may also be provided. After machining, there is automatic delivery of parts to the unloading conveyor. Drill units are mounted on power driven sliding sub-bases to facilitate tool changing. **Morris Machine Tool Co.**, 933-17 Harriet St., Cincinnati 3, O.

Circle 401 on Inquiry Card



Grinder and Polisher

Used in applications ranging from small electronic and business machine parts to automotive parts, saw blades, floor tile, extrusions, etc., line of grinding, polishing and deburring machines is called the Straight-O-Matic. Illustrated machine, Model R600C-3, employs three abrasive belts over one conveyor belt and is equipped with wet grinding, oil mist applicator, automatic tracking, and pneumatic tensioning of the 10-inch wide abrasive belts. The unit makes possible a three-grit polishing sequence, a three-step stock removal for sizing, or combinations of polishing and grinding.

Models are available for surfacing one or both sides of coil or strip, with either wet or dry operation. Smaller component parts can be ground, polished or deburred with either a wet or a dry operation on the conveyor machines. Standard models handle material up to 10 inches wide and 4 inches thick. Units or grinding heads can be arranged in series to perform multiple consecutive grinding and polishing operations with only one material handling. The neoprene rubber conveyor belt allows for relatively close tolerance work. **Curtis Machine Div., Carborundum Co.**, Jamestown, N. Y.

Circle 402 on Inquiry Card

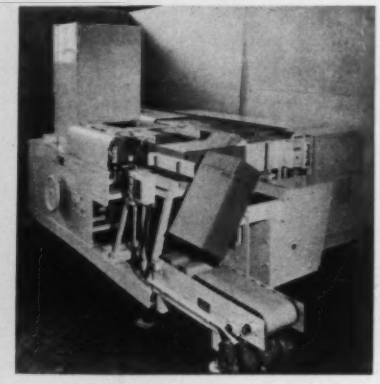
Paper Tape Console

Consisting of a 400 character per second photoelectric reader and a 60 character per second punch, high speed paper tape input-output unit increases input and output speed of the Alwac III-E electronic digital computing system. The unit provides rapid read-in and punch-out of data on paper tape and greatly increases the available productive computing time of the Alwac III-E unit, because the speed of the computer is not delayed by slower input and output devices.

The console also increases the system's range of applications to

include unlimited storage of data —inventory, payroll, personnel, sales, production and accounting records—on inexpensive paper tape. Modular construction of the new high speed paper tape unit permits the purchase of either punch or reader if the application does not require both. **Logistics Research Inc.**, 141 S. Pacific Ave., Redondo Beach, Calif.

Circle 403 on Inquiry Card

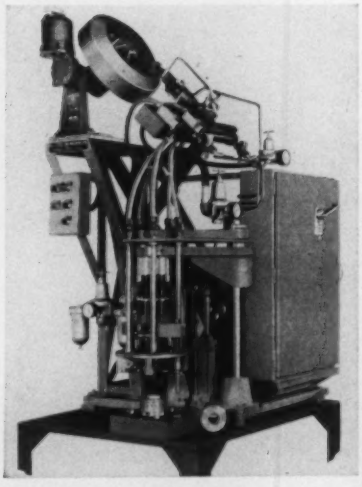


Case Packer

Fully automatic feeder-former-positioner-loader with magazine accommodates end opening style corrugated paper board shipping containers for canned products. The machine feeds out flat corrugated shipping containers, forms, positions and loads them at the rate of 15 cases per minute. Illustrated model is capable of loading shipping containers with twelve 46-oz cans measuring 4¼ inches in diameter by 7 inches high. A machine for handling six #10 cans, measuring 6 3/16-inches in diameter by 7 inches high, is also available.

The entire operation is accomplished automatically, with a single operator required part-time to keep the magazine supplied with knocked-down containers. The machine can be constructed to discharge the loaded shipping container to a top and bottom case sealer or a side sealer, resulting in a case which is loaded, sealed and ready for shipment. The end-loading feature is available without the feeder-former-positioner operation. **J. L. Ferguson Co.**, Joliet, Ill.

Circle 404 on Inquiry Card



Multiple Screw Driver

Designed to automatically feed and drive five screws in a transmission stator, automatic multiple screw driver operates without indexing or fixtures. Instead of handling one screw at a time, all five are driven into the stator simultaneously and with precision torque control. The multiple screw driver is mounted on a plate, as a component part of the stator assembly conveyor line, and is actuated by a limit switch when a stator is brought into proper location by the conveyor.

The unit handles 700 stators per hour, driving home 3500 clutch head screws in that time. A feature of the torque control device is the traveling head which carries five pneumatic air drivers. The air drivers provide accurate torque control, independent of minor air pressure variations. The torque can be adjusted to suit the exact job requirements, without the necessity of changing the air pressure or the speed of the motors. The driver bit is provided with a 1-inch travel in a spline to allow for screw height variations during rundown. Constant force is obtained during the full 1-inch travel, due to the air pressure loading of the spindle, to hold the drive bit against the screw head.

The spring loaded auxiliary head, with fingers, forms the lower screw escapement for positioning and holding the individual screws under the drivers. The head is so designed that when it approaches the workpiece and the air motors are about to engage, the screws are released into their proper holes. Hopper feed system consists of a rotating gravity feed hopper with a slide and escapement, designed to feed the screws at the proper time. The multiple screw driver is self-contained and ready for operation when wired to a 440v, 60-cycle line and connected to a 1-inch air pipe line with line pressure. **D & L Tool & Machine Co.**, 990 S. Oakwood Ave., Detroit 17, Mich.

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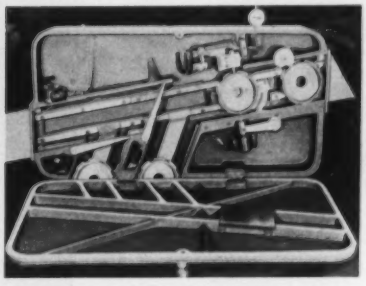
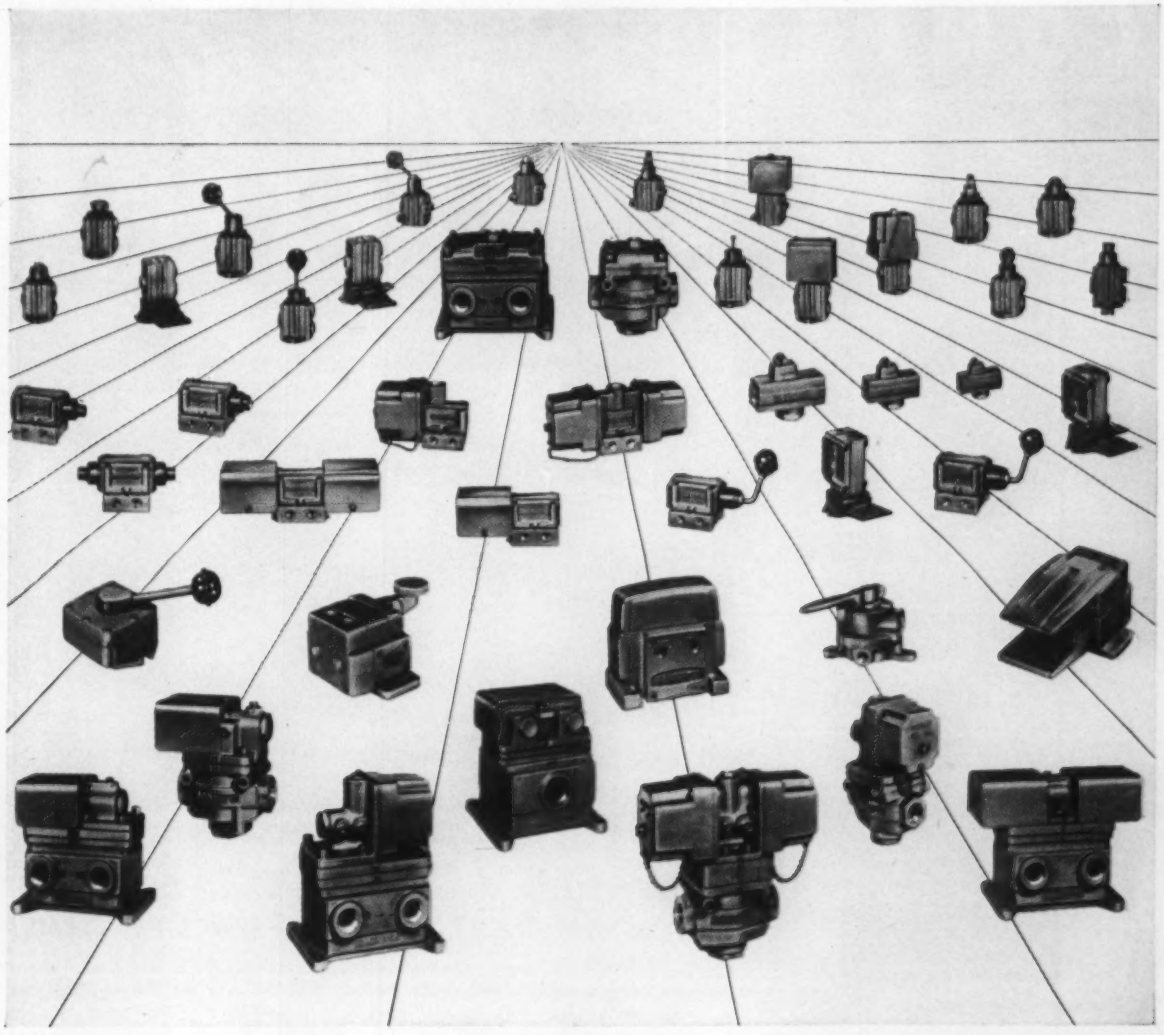


Monitoring System

Used for checking the root diameters of external splines or keyways on drum type parts, automatic probe type monitoring system employs a gaging action based on point contact of individual probes. The preset probes, by means of controlled indexing, check any or all root diameters of a part. The machine is designed for integration into automated production lines.

Oversize, undersize and correct size splines or keyways produced on hobbers, shapers, shavers or Shear-Speed machines are gaged automatically, using the root diameter as a reference base. A two-point contact system—a lower stationary probe and an upper floating probe—measures 100 per cent



These valves like tough jobs

Discriminating engineers are finding that out. More and more of them are specifying Hannifin valves for every kind of directional air control—including the really tough jobs.

There are plenty of reasons why: Inspired simplicity of design. Fewer parts—and *those* easily and quickly replaceable. Ability to serve a wide range of applications with fewer valve models. And—above all—fast, smooth operation.

Your Hannifin man will gladly give you the whole story. We'll tell you where to get in touch with him—after you examine the big Hannifin catalog.

AIR CONTROL

HANNIFIN

VALVES

For this complete catalog **showing all the Hannifin directional air control valves, write to Hannifin Corporation, 541 South Wolf Road, Des Plaines, Illinois.**

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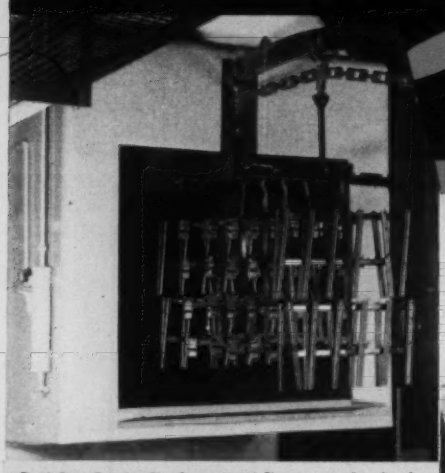
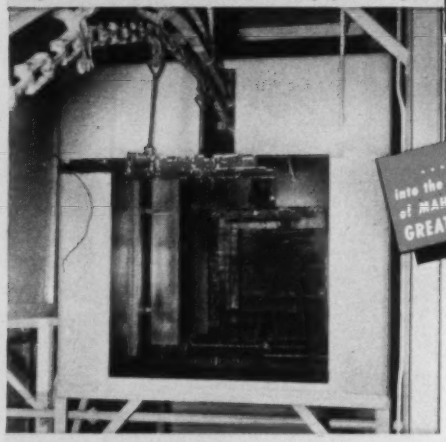
COMPLETE *Finishing* SYSTEMS

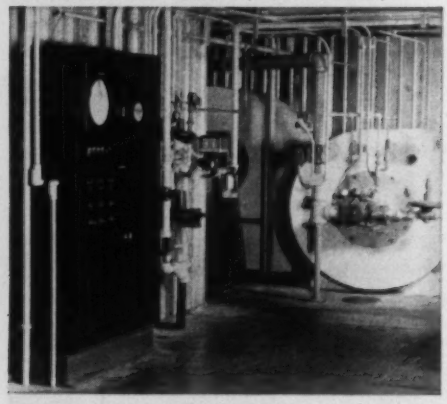
. . . for ENAMELS • LACQUER • PAINT • VARNISH



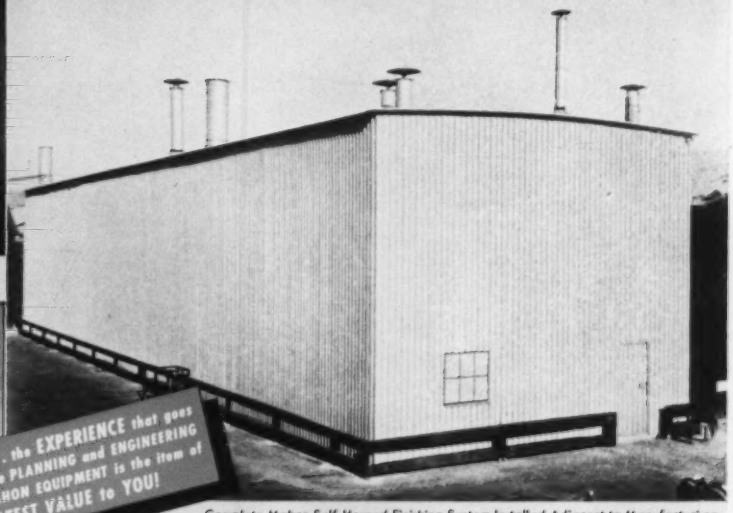
Truck Parts Entering Five-Stage Metal Cleaning and Rust Proofing Machine in the Mahon Self-Housed Finishing System at Right.



Entrance End of the Mahon Flow Coater. Equipment is provided to maintain Paint at a Constant Temperature and Viscosity.



Mahon Control Panel which Houses Temperature Recorders, Control Switches, Signal Lights and Automatic Safety Devices.



. . . the EXPERIENCE that goes into the PLANNING and ENGINEERING of MAHON EQUIPMENT is the item of GREATEST VALUE to YOU!

Complete Mahon Self-Housed Finishing System Installed Adjacent to Manufacturing Buildings at International Harvester Company's Plant, Fort Wayne, Indiana.

SELF-HOUSED Mahon Finishing System OUTSIDE of PLANT Solves Many SPACE PROBLEMS!

In industrial plants where adequate space is not available, or where floor space and headroom restrictions would seriously interfere with the planning and the engineering of an efficient and economical production finishing system, Mahon engineers recommend installation of a Self-Housed Finishing System on the roof of the plant, or outside the plant adjacent to manufacturing buildings . . . the installation illustrated above is an excellent example. In such installations, no restrictions are imposed by either floor space or headroom; consequently equipment can be planned and coordinated for maximum efficiency. In this particular finishing system, the equipment is installed on two levels . . . the Five-Stage Metal Cleaning and Rust Proofing Machine, the Flow Coater, the Ventilated Drip Enclosure, and the Control Panel with Recording Instruments, are located on the ground level. The Dry-Off Oven, Finish Baking Oven, Oven Heating Units, and Air Supply and Exhaust Equipment are located above on the second level. The roof and walls, which house the complete system, are an integral part of the Oven Construction. This is a highly satisfactory Mahon solution of one manufacturer's production painting problem. When you are confronted with a finishing problem, you, too, will want to discuss it with Mahon engineers . . . you'll find them better qualified to advise you on both methods and equipment requirements. See Sweet's Plant Engineering File for Information, and typical Mahon Installations, or write for Catalog A-657.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

SALES-ENGINEERING OFFICES in DETROIT, NEW YORK and CHICAGO

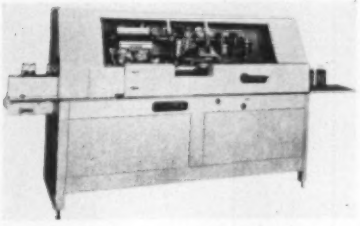
Engineers and Manufacturers of Complete Finishing Systems—including Metal Cleaning, Pickling and Rust Proofing Equipment, Hydro-Filter Spray Booths, Dip and Flow Coaters, Filtered Air Supply Systems, Drying and Baking Ovens, Cooling Tunnels, Heat Treating and Quenching Equipment for Aluminum and Magnesium, and other Units of Special Production Equipment.

MAHON

of production from a single machine or a bank of machines. Both a visual and electrical check of production accuracy is provided within the specified tolerances of the spline root diameter.

All operating parts are lubricated from a single central source. Versatility of operation is afforded by adjustable features of the gaging and feeding functions which allow the equipment to accommodate variations in part size at different rates of production. **Michigan Tool Co.,** 7171 E. McNichols Rd., Detroit 12, Mich.

Circle 406 on Inquiry Card



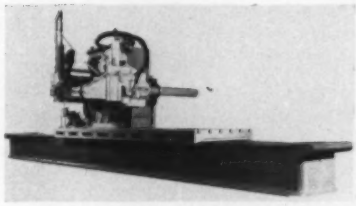
Bag Sealer and Header

Up to 70 bags are processed per minute by bag sealing and header applying unit. The machine receives filled cellophane bags from a conveyor, times the bags into the machine at a predetermined uniform rate, tucks the gusset, applies header or label, and heat seals both the bag and label. The machine handles plain or thermoplastic coated labels and can be adjusted for processing a wide range of bag sizes. **Peters Machinery Co.,** 4700 Ravenswood Ave., Chicago 40, Ill.

Circle 407 on Inquiry Card

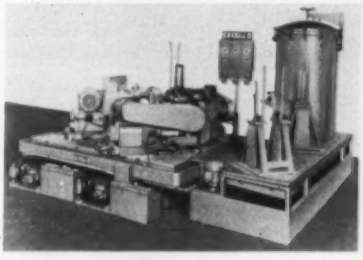
Profiling Machine

High production 360-degree profiling, three-dimensional contouring and swarf or twist machining can be performed in steel, aluminum or titanium with the Arrow Profiler. Using a responsive hydraulic tracing valve, the operator manually traces a template, and the cutting tool machines profiles or three-dimensional contours accurate within 0.005-inch. For swarf or twist cuts, the spindle is mounted on arc shaped ways, permitting the spindle to pivot 20 degrees either side of a vertical center line. The pivoting action of the spindle is actuated by a second tracing valve mounted on the cross carriage.



The machine is equipped with a 20 hp hydraulic powered spindle with speeds from 37 to 3000 rpm, giving it the necessary range and power to machine steel as well as aluminum and titanium. Speed changes are made through pickoff gears, providing up to 30,000 inch-lb torque at 37 rpm. **Arrow Engineering Co. Inc.,** 120 E. Market St., Indianapolis, Ind.

Circle 408 on Inquiry Card



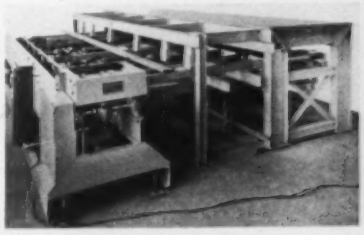
Three-Slide Grinder

Designed and built for large aircraft engine builders, three-slide grinder automatically finishes the curved surfaces of jet engine vane roots. The machine is equipped with four grinding wheels mounted on three spindles. Two of the spindles each carry a single wheel, while the third spindle carries two wheels. Three of the wheels are 15 inches in diameter, and the fourth is 20 inches. Wheel widths range from ½ to 1¾ inches. Dimensional tolerances are held consistently.

Each slide is equipped with a cam-type universal diamond dresser which shapes the respective wheels as part of the automatic machine cycle. The slides automatically compensate for the abrasive removed when the wheels are dressed. Slide movements include rapid approach, an adjustable fine feed and an adjustable spark out period.

Two interchangeable trunnion fixtures are furnished with the machine to permit nearly continuous operation. While one fixture rotates the vanes through the grinding cycle, the second fixture is being loaded by the operator. Loading racks support the trunnions when these are out of the machine. **Ex-Cell-O Corp.,** 1200 Oakman Blvd., Detroit 32, Mich.

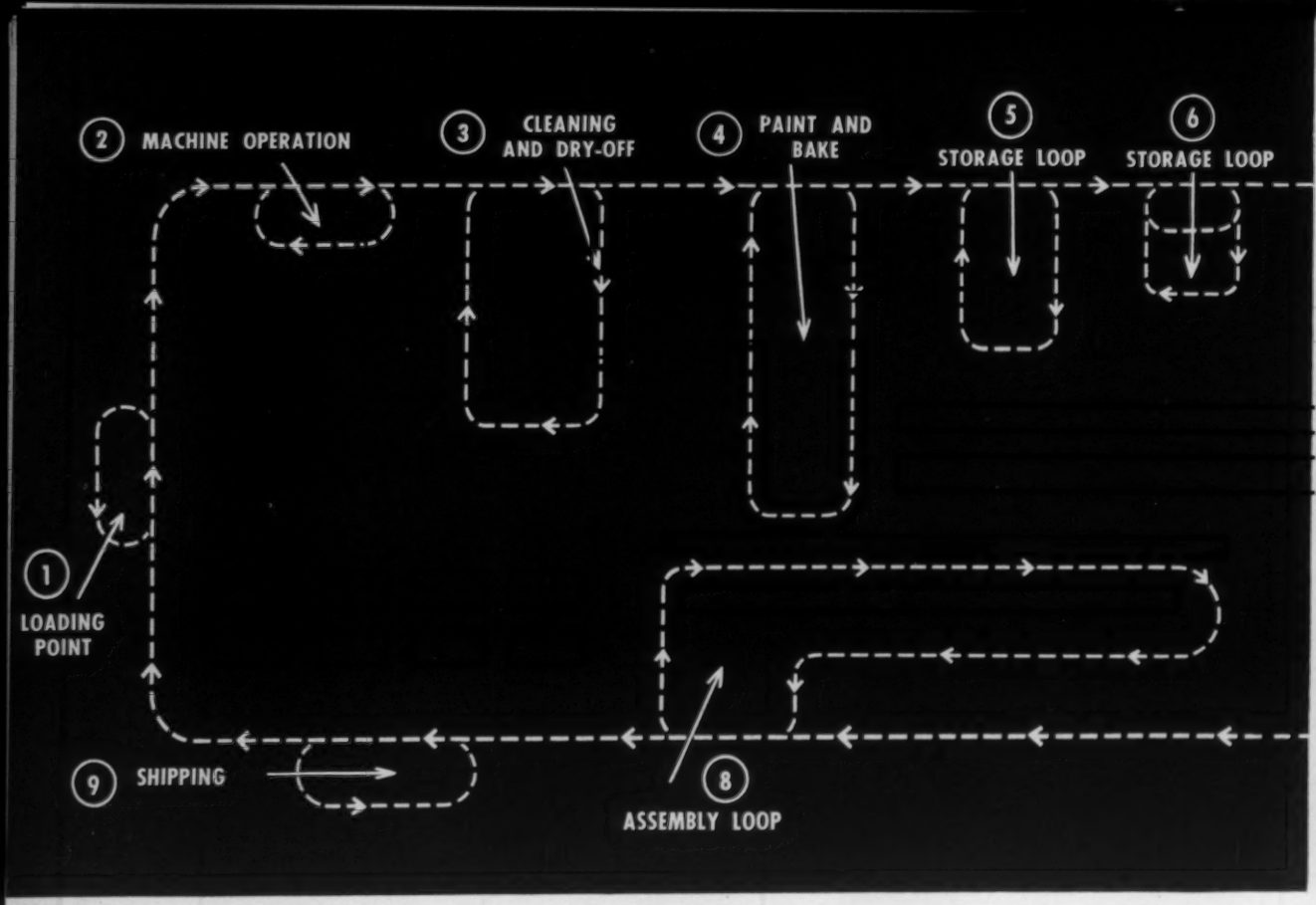
Circle 409 on Inquiry Card



Bar Hopper Feeder

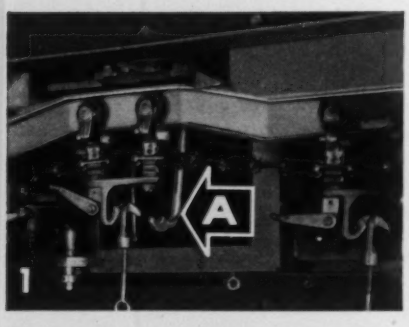
Available for various sizes of bars or tubes, to serve shears, furnaces, presses, storage racks, etc., automatic bar hopper feeder consists of three sections. (1) The hopper on the right is designed to receive 10,000-lb bundles of 2-inch diameter by 20-ft long round steel bars or tubes from an overhead crane. (2) The transfer table in the middle transfers and meters the bars (or tubes) from the hopper to the V-roll conveyor. (3) The powered V-roll conveyor on the left feeds the bars (or tubes) to the cutoff machine or a furnace.

The bottom of the hopper consists of steel rollers which are to be converted into live rollers at a later date. The bottom of the near side of the hopper is open to permit transfering the bars from the bottom of the hopper onto the transfer table. The transfer table consists of cross-chain conveyors mounted on steel supports. The chains drag the bars from the hopper under a set of metering steel hands to limit the thickness of the bars to one bar as they are delivered to the escapement fingers. These fingers hold all bars until the conveyor signals that it is ready for another bar, at which time one bar is released to the conveyor and the rest are held

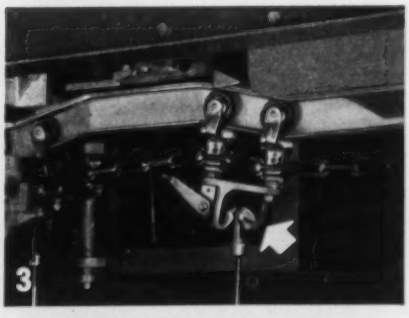


with new Trans-Free conveyor by Allied

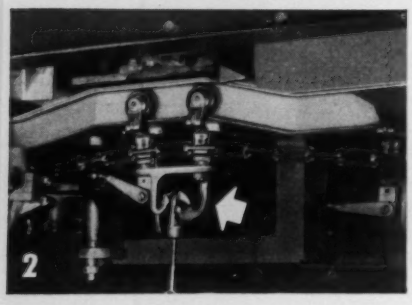
Completely Automatic Dispatching



1 Automatically dispatched for transfer from live line to free, the load bar rises on live track to free line level, mechanically triggers transfer hook A on free line swinging it forward toward interception position.

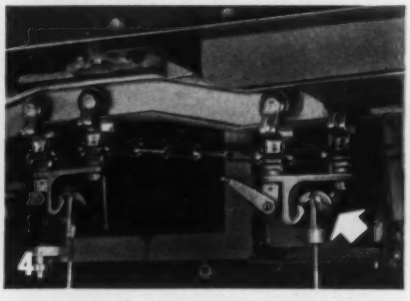


2 Perfect synchronization assures coordination of the two lines, transfer hook here engages load hook. Transfer of load is now ready to be completed mechanically without use of air cylinders, solenoid switches, etc.

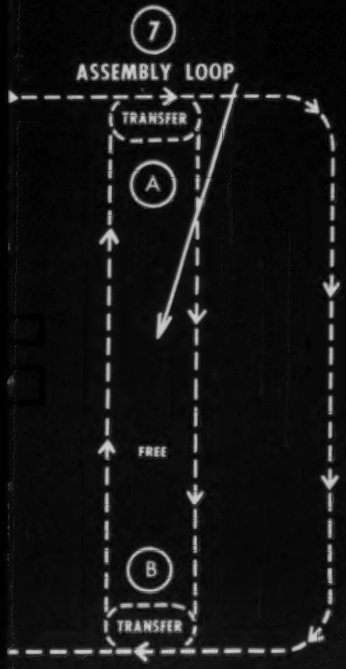


3 As live line rail begins dip to original position, load hook and transfer hook are both firmly engaged giving positive load control throughout transfer. Incoming, outgoing loads are controlled to prevent collision.

4 Load hook dips below level of transfer hook leaving load on the free line hook to go to intermediate operations or storage. Free line may be powered, load returned to live line at some other point, if desired.



Circle 581 on Inquiry Card



1. Loading Point—raw stock loaded on Trans-Free at receiving department or stores.
2. Machining or other Fabrication Operation—may be first of several—hoist permits small parts containers to be raised or lowered from Trans-Free at will.
3. Cleaning and Dry-Off.
4. Paint and Bake—baking cycle may be varied.
5. Storage Loop—selectively stores intermixed parts automatically and recalls individual parts as required by schedule.
6. Storage Loop—same as (5) except individual parts are manually positioned for dispatching.
7. Assembly Loop—selects parts for assembly area automatically. May be first of several—may return processed parts to main line at "A" or "B" as schedule requires.
8. Assembly Loop—automatically selects parts. Returns to main line upon completion of operation. Loop size and shape may be varied.
9. Shipping Loop—selects all completed parts on main line.

and Product Handling from loading point to shipping dock

Trans-Free is mechanical. There's nothing electrical, nothing hydraulic. No switches, no belts, no "downhill" transfer points. So complicated maintenance problems are virtually eliminated.

Trans-Free is automatically dispatched. You can unload to, from, and at any pre-selected combination of stations. Your load timing, transfer, circulating storage and load control through transfer points—all are automatic.

Loaded carriers leaving any work station are sent automatically to the next designated one. So, you handle many different parts at once, unloading at any station desired. As carriers are emptied they return to the loading area.

Trans-Free is economical. It uses standard track and trolley. So you can integrate Trans-Free with existing facilities saving on your initial investment. With Trans-Free you have truly automatic handling, a system that gives you: lowered labor costs; integrated conversion; and—very important—completely mechanical operation, a big maintenance saving.

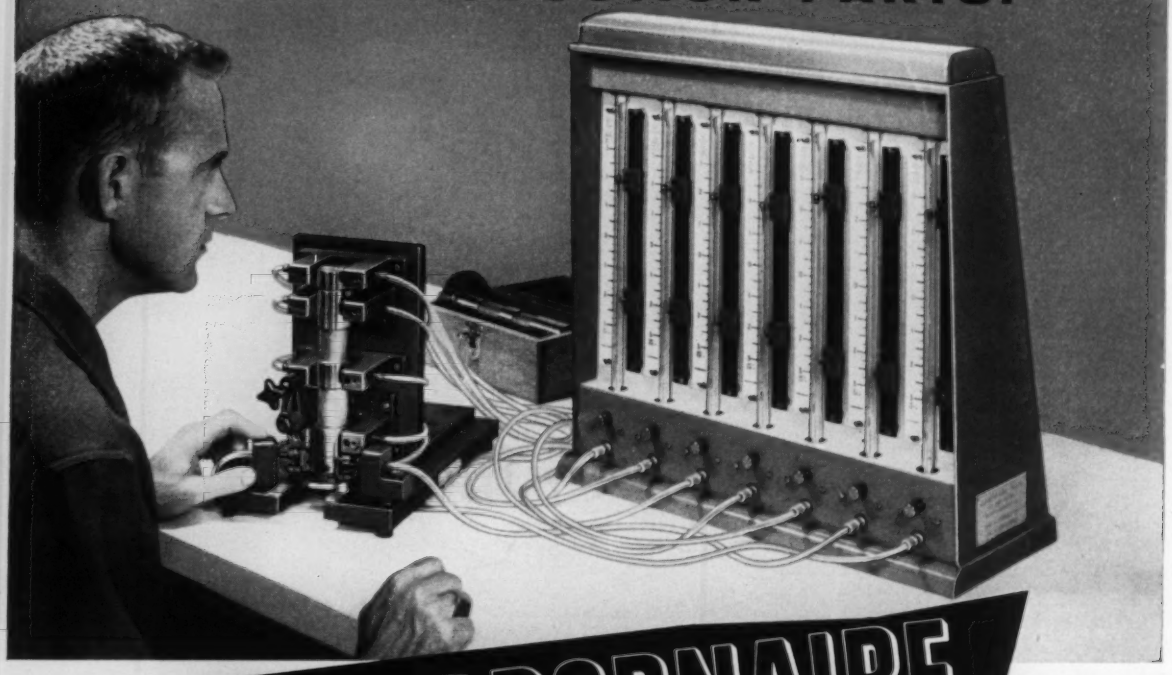
Let us send you the complete story on Trans-Free. Simply write to Allied Conveyors (see address below). Or, next time you are in Detroit see the unique Trans-Free conveyor system in actual operation. The phone number is TWinbrook 2-3040.

ALLIED CONVEYORS

ALLIED STEEL AND CONVEYORS • DIVISION OF THE SPARKS-WITHINGTON CO.

17365 HEALY AVENUE • DETROIT 12, MICHIGAN • CABLE ADDRESS: ALCON

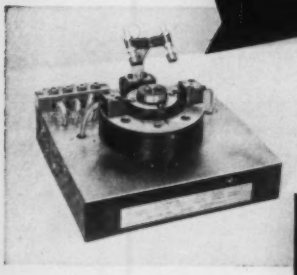
Speed Inspection
OF PRODUCTION PARTS!



NEW

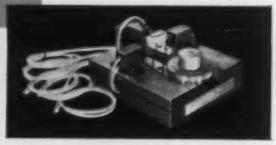
DEARBORNAIRE

MULTIPLE COLUMN AIR GAGING INSTRUMENTS



Special Air Gaging Fixtures designed and built to meet your particular application requirements. Complete engineering service available upon request.

Send part print showing all dimensions to be checked and tolerances required for prompt quotation and delivery.



To speed inspection of production parts, new Dearbornaire air gaging instruments are now offered in multiple column units designed to permit more accurate simultaneous checking of as many dimensions as may be required for a given part. What's more, each unit incorporates all of the advanced design features which have made Dearbornaire the most practical, most versatile column type instrument ever produced . . .

- New higher rated pressure system and built-in circuit restrictions make them virtually self-cleaning, reduce maintenance to a minimum.
- New glass tube has a characterized internal taper which provides positive linear accuracy over the full extent of the calibrated scales.
- Easy-to-read Zero-centered scales permit use of instrument for normal inspection, statistical quality control, and as a tool setting gage.
- Interchangeability of component parts simplifies conversion from one amplification to another, reduces spare parts inventory costs.

Plus a complete line of air gage spindles, rings, snaps and cartridges all precision finished to give you greater accuracy, longer wear life. Free demonstration arranged upon request. Write for details today!

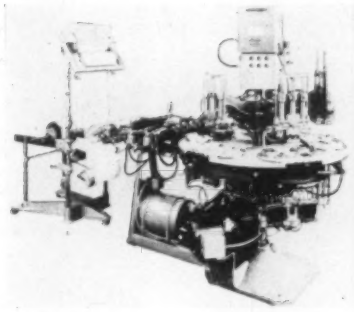
AIR GAGE DIVISION
DEARBORN GAGE COMPANY
22038 Beech Street • Dearborn, Michigan

Circle 651 on Inquiry Card

back until the next bar is called for.

The roll conveyor feeds the bars to the cutoff machine at a specified rate of speed. When the rear end of the bar approaches the cutoff machine, a flag signals the escapement fingers that it is ready for another bar. The next bar is then delivered, permitting the cutoff machine to operate at full capacity continuously. **Spurgeon Co.,** 23501 Hoover Rd., Van Dyke, Mich.

Circle 410 on Inquiry Card



Box Making Machine

High speed package making machine, which is designed for the low-cost production of acetate boxes, is called the Vue-Matic. In one installation, the machine produces transparent boxes for marking tape and pen sets at the rate of 900 per hour.

The Vue-Matic works directly from acetate roll stock slit to the proper width. Maximum sheet size is 10 by 14 inches. Maximum box sizes are 2 by 6 by 10 inches or 3 by 4 by 8 inches with a ½ by¾ by 4-inch minimum. A special unit automatically embosses or imprints in gold or bronze leaf on the box as it is formed, without slowing production rates. One operator is required to run the machine.

Companion to the Vue-Matic is the Alpha-Autofeed, a semiautomatic wrapper and gluer. This machine affords quick changeover for short or long runs of tight wrapped stayed boxes. It may be used to produce setup boxes that form the bottom of transparent package units. **High Production Machine Co., Div., E. G. Staude Mfg. Co.,** 2675 University Ave., St. Paul 14, Minn.

Circle 411 on Inquiry Card

New TOLEDO Weight Data Systems

Originating, Transmitting, Processing, Recording

Digital Weights Transmitted Anywhere

- Adding Machine
- Electric Typewriter
- Tape Punch
- Card Punch
- Digital Indication

Toledos now provide electronic wings for your weights! A great time-saver combined with Toledo accuracy! Even though the weights originate in production, inspection, testing, shipping or receiving, the weight data travels instantly for remote digital recording in the form you want it. This new forward step brings a closer than ever link between good weight control and high accuracy in accounting records.

Automatic Bulk Weighing

You get *printed and totalized weight records* instantly—on a remote electric adding machine—with this Toledo Automatic weighing, recording and totalizing system. Its job is to keep cost-control tab on bulk material such as flour going into truck or carload shipments.

Product Testing and Sorting

Toledos today automatically check and classify a wide range of parts. Here leaf springs for autos are tested and classified automatically by this custom-engineered Toledo at the rate of 600 an hour!

Dial location wherever you choose with Electronic Toledos

A new type of Toledo—the Electronic Load Cell Scale—eliminates mechanical connections between platform and scale head. This gives new flexibility to testing as well as weighing applications. Dial head can be located wherever desired. Also, the weight data can be processed in a variety of recorders and office machines. Ideal for many dynamometer, motor truck, hopper and custom test device applications.

Batching in Automatic Interlocked Systems

This Toledo cabinet interlocks 22 scales in an automatic batching system. Through TOLEDOmation all ingredients are fed into successive batches in proper sequence, including operation of gates and feeders. In addition, all dials are automatically scanned and the digital weight data is recorded on an electric typewriter for each batch.

Whether you are moving forward to a plant-wide weight control system, or are considering the closer linking of your weighing with accounting through modern Toledo weight data processing units, you will find that a discussion with a Toledoman may be helpful. We will be glad to send booklets on remote digital weights, or on "a plant-wide look at weighing". Write Toledo Scale Company, Toledo 1, Ohio.

TOLEDO®

HEADQUARTERS FOR SCALES

Circle 582 on Inquiry Card

MICRO SWITCH Precision

...FIRST IN PRECISION SWITCHING

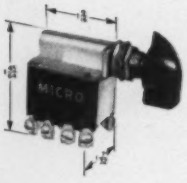
HOW MICRO SWITCH ENGINEERING SERVICE can keep a small switch from becoming a BIG PROBLEM in your design

MICRO SWITCH Engineering Service is a two-way street. Field engineers and factory engineers work together to make sure you get the right MICRO SWITCH precision switch for your application.

This teamwork between experienced switching specialists assures that the precision switches you incorporate in your equipment are the right switches for your application and will give reliable, dependable, day-in, day-out service.

You can take advantage of this teamwork by calling MICRO SWITCH today. Switching specialists—with close contact at the world's largest headquarters for precision switches—are available at branch offices in key cities.

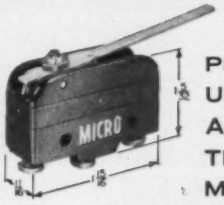
CONTROLS MANY CIRCUITS WITH ONE MANUAL MOTION



This three-position, rotary-type toggle switch offers all the advantages of a toggle switch mechanism with longer operating life and better detent "feel." Shown is a four-pole double-throw switch with 12 terminals. It is maintained in all three actuation positions, on-off-on. This switch can handle a high electrical load and has passed severe tests for impact, shock, acceleration and vibration.

(Send for Data Sheet 112)

PRECISE, UNERRING ACTUATION THROUGH MILLIONS OF OPERATIONS



Adjustable lever actuator permits close adjustment of switch operating point without removal from mounting. It provides unusually reliable service on such equipment as timers, computers or other multiple-mounted devices which require precise, unerring operation through millions of operations. Available with normally open, normally closed double-throw or split-contact circuitry.

(Send for Data Sheet 100)

FOR PRECISE PERFORMANCE UNDER MOST EXTREME CONDITIONS

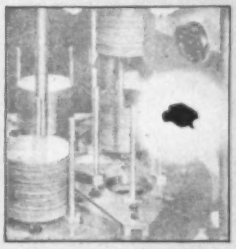
MICRO SWITCH "EN" switches are capable of reliable, long-life performance under extreme environmental conditions. They are completely sealed, cylindrical and can be mounted wherever a through hole can be provided. Variations of the "EN" are capable of actuation by almost any means. Available in choice of four different contact arrangements. Equal in performance to many switches twice the size.

Switches have uses unlimited

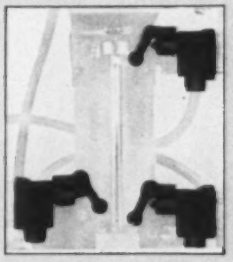
Switches put "THINK" into this press transfer feed

Here is a typical example of how a manufacturer improved his product. With MICRO SWITCH Precision Switches designed into the press, blanks are loaded and fed automatically, dangerous manual feeding is eliminated, mistakes are "erased" without interrupting production. This product improvement was due in no small measure to the help of MICRO SWITCH application engineers.

For more information for your design engineers, write for Catalog 83.



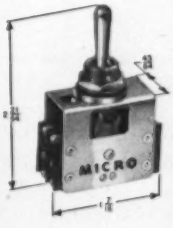
When a stack of blanks is nearly depleted, the descending elevator trips this switch which starts a motor and turns the six-station turret to the next full station for blanks.



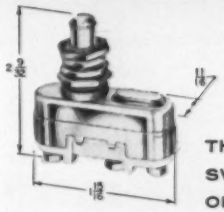
Plunger which picks up the blanks is controlled by switches shown. Upper switch stops the press if the blanks do not reach level of gripping fingers. Switch at left brings new stack of blanks into position. If stack doesn't come into position, the third switch stops press.

When two blanks stick together and feed into the press they trip this switch which actuates a solenoid and opens a trap door in the press bed. The blanks fall through, the press goes on uninterrupted.

SWITCH "REMEMBERS" CIRCUIT WHICH WAS LAST ACTUATED



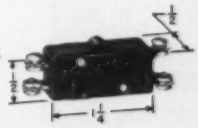
This is the first of a new series of "electrical memory" toggle switches. The switch indicates through a pilot light or buzzer which circuit was last actuated. The assembly uses one pole of its four-pole circuitry to indicate which circuit was last operated. Use of this switch simplifies basic circuit designs of radar units, computers, aircraft control panels and other similar devices. Seal prevents entrance of liquids and dust. Basic switches are Underwriters' Listed at 5 amperes 125, 250 volts a-c, d-c rating at 28 volts-3 amperes at sea level, 2.5 amperes at 50,000 feet (inductive); 4 amperes at sea level and 50,000 feet (resistive); maximum inrush, 15 amperes.



THIS SWITCH OPERATES RELIABLY AT TEMPERATURES FROM −50° TO +1000° F

Use of laboratory-tested, heat-resistant materials makes this switch an extremely dependable component for use in applications where high temperatures are present. It will operate satisfactorily in a temperature range of −50° to 1000°F. Contact arrangements are single-pole double-throw. Switch is available in panel-mount design (shown) or with pin- or roller-plunger actuators.

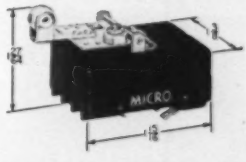
(*Send for Catalog 77*)



A TWO-CIRCUIT SWITCH WITH ACCURATE REPEATABILITY

This switch uses a snap-action spring to provide quick make and break of both contacts in each double-break circuit. It is Underwriters' Listed for 10 amperes 125 or 250 volts a-c; ½ H.P. 125 volts a-c; 10 amperes 30 volts d-c.

(*Send for Catalog 62*)



TWO SWITCHES OPERATED BY A SINGLE LEVER ACTUATOR

This is an assembly of two single-pole double-throw switches. It provides for switching of two isolated circuits at the same time. The basic units are listed by Underwriters' Laboratories at 15 amperes 125, 250 or 460 volts a-c; ½ ampere 125 volts d-c; and ¼ ampere 250 volts d-c.

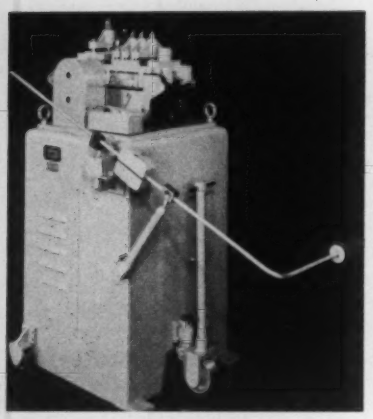
(*Send for Data Sheet 100*)

MICRO SWITCH, a Division of Honeywell, pioneered the manufacture and development of precision snap-action switches.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

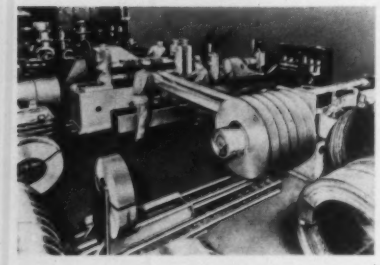


Straightener Unit

Addition to line of automatic press room equipment is designated Model PDS-4½ power drive straightener. The unit is used to straighten material up to 4½ inches wide by ⅛-inch thick. The straightener has a pair of power driven take-in rolls and six straightening rolls. The upper three are individually adjustable and the lower three are power driven.

The straightener assembly is of hinged construction so that it can be opened for easy threading of the end of a new coil. Unit is furnished with forward, stop and reverse controls, indicators on straightening rolls, casters for portability, limit switch loop control arrangement and a ½-hp variable speed drive motor. **U.S. Tool Co.**, Ampere (E. Orange), N.J.

Circle 412 on Inquiry Card

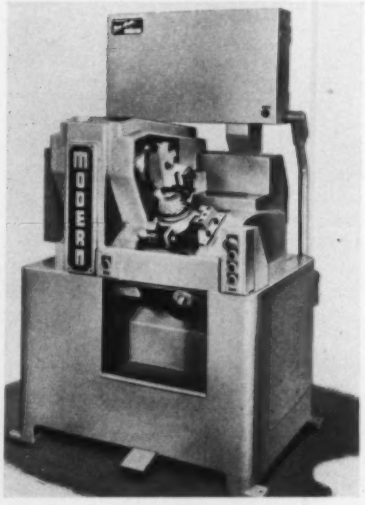


Cone Type Uncoiler

Featuring adjustable tension control, automatic or semiautomatic lateral adjustment, and from 10 to 32-inch range for inside coil diameter, payoff cone type uncoiler is designed for slitting and cut-to-length lines. The threading motor on the payoff cone type uncoiler reel is reversible, and long stroke hydraulic cylinders actuate the cones which, on a 72-inch line, may be adjusted from a minimum of 6 ft to a maximum of 80 ft.

Top and bottom mandrels are accessible for fast tooling changes and are constructed for optional drives—either power or pull-through. The gear box is designed specifically for slitter application. The recoilers can be used with optional ac or dc drive and work either with hydraulic actuated separators or disk separators. **Universal Gear & Machine Co.**, 1301 E. McNichols Rd., Detroit, Mich.

Circle 413 on Inquiry Card



Hypoid Pinion Deburring

Developed for deburring and chamfering medium to large hypoid pinions with short or long shafts, Model BMHP-15 single-station machine handles pinions of eight to 15 teeth, with an OD range of 3¼ to 8 inches and with shaft lengths up to 15 inches, at production rates up to 280 gears per hour. Using a pushbutton controlled, completely automatic machining cycle, operation is so simplified that one operator can easily handle two machines.

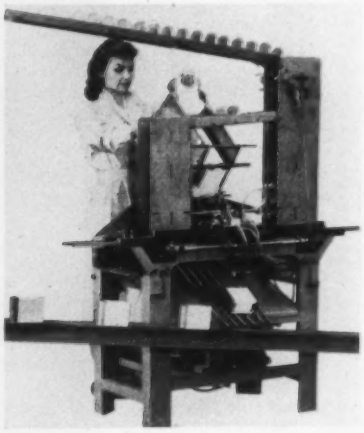
The machine deburrs and chamfers acute angle profile and part of the root at the toe and heel ends of each tooth, and when required, produces a peripheral chamfer on the large end, removing sharp edges. All sharp corners well into the root of the tooth are eliminated by the cutting action which generates the chamfer uniformly.

Pinions are inserted, shaft down, in the workstation, and the radial locator lever is actuated by the operator to make certain the part is positioned properly. This automatically energizes the clamping circuit so that the part can be clamped by pressing a pushbutton. The machining cycle is started by means of two pushbuttons located on opposite sides of the machine for maximum operator safety. **Modern Industrial Engineering Co.**, 14230 Birwood Ave., Detroit 38, Mich.

Circle 414 on Inquiry Card

Can Loader

Designed for loading cans into multiple packages, variable speed machine automatically loads up to 50 packages per minute. The machine handles two, three and four-can multiple packages. Machine was developed to automatically pack a variety of Can Band—a canned item multipack—tab styles, can heights and diameters.



The Can Band loader handles cans in single line only. One operator can handle two machines. Since cans are fed and loaded automatically, the operator's only duty is to keep the carton feed hopper filled and to supervise operation, starting and stopping the machine in accordance with the can supply. **Container Corp. of America, Mechanical Packaging Dept.**, 5000 Flat Rock Rd., Philadelphia 27, Pa.

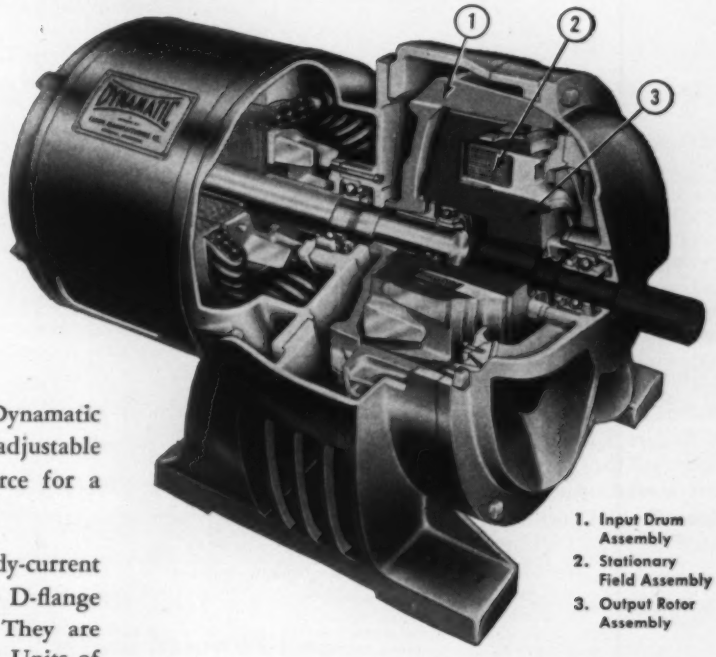
Circle 415 on Inquiry Card

Infinitely Adjustable Speed from an AC Source with the NEW

EATON

DYNAMATIC®

Ajusto-Spede® Drives



1. Input Drum Assembly
2. Stationary Field Assembly
3. Output Rotor Assembly

The newly announced stationary field Dynamatic Ajusto-Spede® Drives provide stepless adjustable speed from an alternating current source for a wide range of industrial applications.

These air-cooled, stationary field eddy-current couplings are mounted integrally with D-flange open drip-proof squirrel cage motors. They are available in capacities from 3 to 75 HP. Units of the same design and capacities are also available without motors.

This new stationary field design eliminates the use of rotating coils, brushes, slip rings, and commutators, holding wear and maintenance to an absolute minimum. Dynamatic electronic or magnetic amplifier controls, in combination with these drives, provide wide latitude in operating functions.

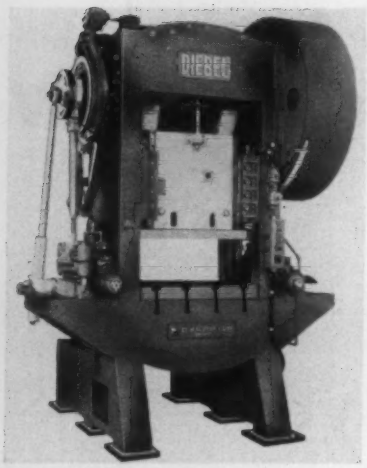
Investigate these Important Ajusto-Spede® Drive Advantages:

Accurate speed control • Wide speed range
Low power losses • Simple construction
Rapid response • Low maintenance cost
Quiet, efficient operation • Remote control

Send for Illustrated Literature Describing these New Stationary Field Drives

EATON — DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

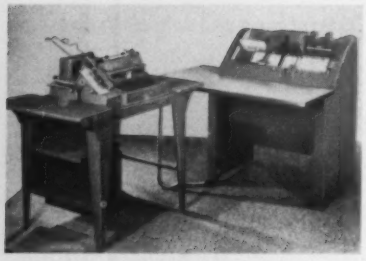
Circle 584 on Inquiry Card



150-Ton Automatic Press

Engineered to handle lamination work, progressive blanking and forming, and large blanking work, 150-ton press is an addition to the line of Diebel automatic presses. The machine includes as standard equipment a cylindrical ram, increased bearing surfaces, air clutch and spring applied brake, special shock mounts and safety shutoff devices. A full recirculating lubrication system for all main bearings and the slide is also included. Width of feed is 18 inches; length of feed is 0 to 13⅝ inches. Speed range of the press is from 70 to 210 strokes per minute. **Di Machine Corp.**, Dept. E, 2710 W. Irving Park Rd., Chicago 18, Ill.

Circle 416 on Inquiry Card

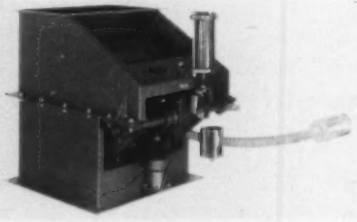


Automatic Writer

Controlled by edge punched cards or punched paper tape, automatic writing machine produces documents, punched paper tape, and tabulating cards simultaneously. Designated the Flexowriter tape and card punch, Model FTCP-8, the unit can produce any style of typed document, from manual to automatic typing. Punching data selected for either tape or tabulating cards is controlled automatically by Flexowriter program tape. A switch control permits the machine to be used for other Programatic applications without the card punch being connected or turned on.

Other features include: Either tape or edge punched cards can be read; alphabetic, numeric and special characters are punched directly in tabulating cards, whether the operation is manual or from tape or edge punched cards; interlocking of the two machines to insure that the card punching is in sequence with the document writing (each card field punched is checked to insure that the correct number of digits is punched in the proper field). Card skipping, duplicating and releasing are controlled automatically through programing in the tape of the Flexowriter. **Commercial Controls Corp.**, One Leighton Ave., Rochester 2, N. Y.

Circle 417 on Inquiry Card

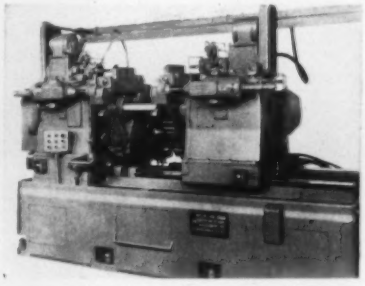


Self-Powered Feeder

Used to control the feed of dry, free flowing materials at rates from 200 to 2000 lb per minute, feeder operates without an outside power source. The feeder is used to handle a variety of materials including grains, food products, seeds, and other similar dry materials.

The feeder is available in seven sizes, to control feeds down to 5 lb per minute, over a 10 to 1 operating range. The self-powered units operate on the principle of balanced weights. The force produced by the material being fed as it falls onto an impact pan is balanced by a preset counterweight. The units are available with automatic shut-off to permit starting or stopping of the feeder, or synchronization with other plant equipment. Feeders are easily adapted for use as semiportable units. **Wallace & Tiernan Inc.**, 25 Main St., Belleville 9, N.J.

Circle 418 on Inquiry Card



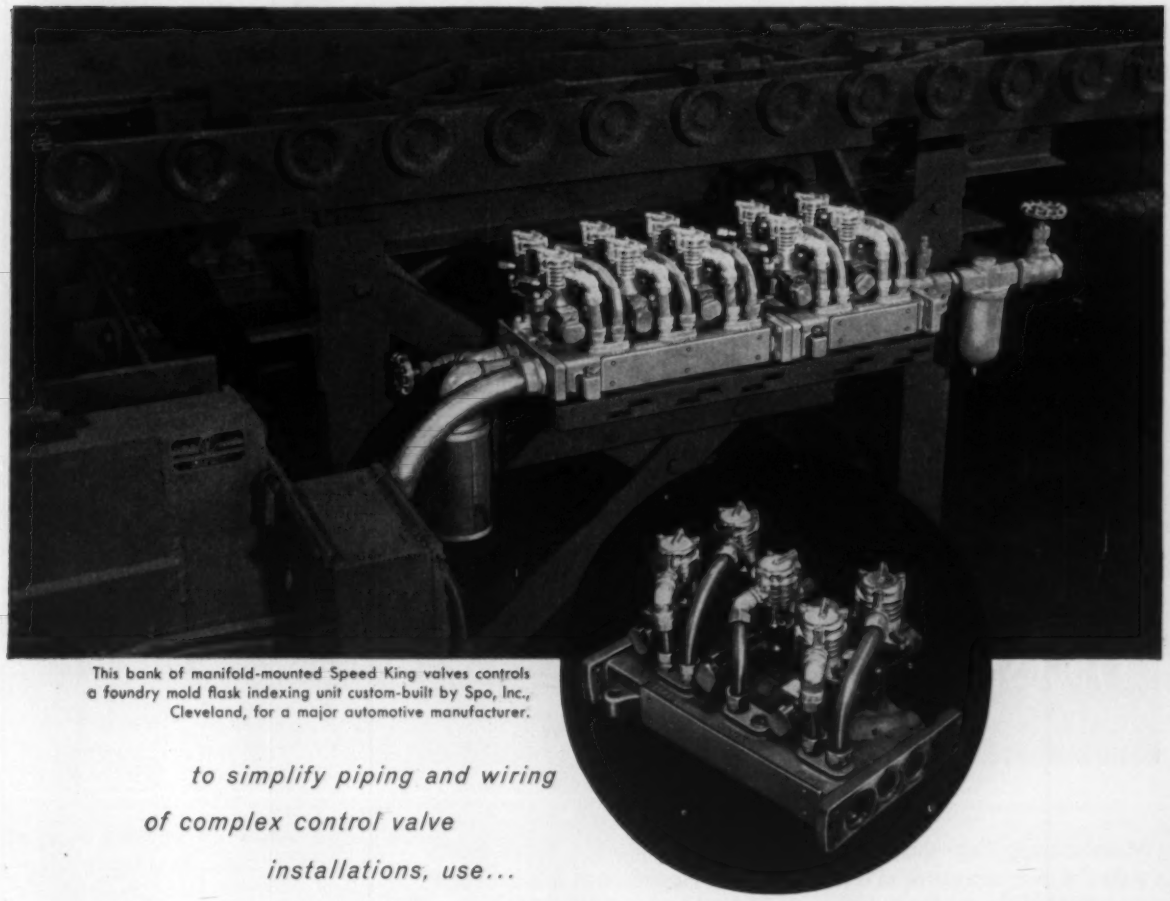
Milling & Centering Unit

Designed to meet the accuracy and production demands of tracer controlled and automatic lathes, Model 3 MCT machine is arranged for complete automatic cycle with parts being manually loaded into the work carrying fixture at the front of the machine, and then progressively indexed to the milling and drilling stations and back to the front of the machine for unloading. As an accessory, automatic loading and unloading can be incorporated in order to fully automate the milling and centering operations.

Unit is quickly set up for lengths up to 48 inches and drills to a depth of 4 inches if desired. Two triangular fixtures with six trunnion vises index 120 degrees between three stations. Station 1 is for loading and unloading. At a second station, double-end center drilling takes place. These three operations (load-unload, mill and center drill) are simultaneous. Operator removes a finished part and places a new piece at the open vise while milling at station 2 and drilling at station 3 are being done.

Work carrying vises and housing supporting the machining units on the right hand side are adjustable for lengths to the full machine capacity. Milling heads are of single-speed type, and are adaptable for carbide tooling. Speed changes are available with change gears. **Motch & Merryweather Machinery Co., Machinery Mfg. Div.**, 888 E. 70th St., Cleveland 3, O.

Circle 419 on Inquiry Card



This bank of manifold-mounted Speed King valves controls a foundry mold flask indexing unit custom-built by Spo, Inc., Cleveland, for a major automotive manufacturer.

to simplify piping and wiring of complex control valve installations, use...

VALVAIR'S NEW SPEED KING MANIFOLDS

Cut material and assembly labor costs on multiple control valve installations . . . use Valvair's new 2 and 3-station manifolds! Common inlet, exhaust and wiring passages, plus equally-spaced cylinder ports, eliminate unnecessary piping and wiring . . . keep installations neat. Cast aluminum manifolds may be ganged for installation of any number of valves. O-rings assure leak-free connections.

Easier in-use service is another benefit! Individual pilots, valves or entire manifolds are replaceable as units to minimize machine downtime.

And, Speed King manifolds *are available for immediate delivery from stock.* Before you engineer new equipment or up-grade machines now in service, investigate the design and cost advantages of Valvair Speed King manifolds. Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

AA-4967

Ganged 3 station Speed King manifolds provide neat piping . . . simplify construction and maintenance of this master control console which operates a battery of Spo, Inc. automated foundry equipment.

PIPING	—1 in. NPT intake and exhaust ports, common to all stations. Pipe threads, both ends, and O-ring grooves.
PORTING	—Optional ⅜ or ½ in. NPT cylinder ports. Side and bottom outlets, flush pipe plugs.
WIRING	—1 ¼ in. conduit passage, with side access cover, common to all stations. Pipe threads, both ends, and O-ring grooves. Pilot leads encased in flexible conduit.
VALVES	—2 or 3 stations for single and double solenoid Speed King valves. 2, 3 and 4-way; remote-operated; speed controlled; and power-centered neutral valves may be used in any number and combination.
MOUNTING	—2 mounting legs per manifold. Kits of O-rings and through bolts, for ganging, also available.

Find your nearest representative in the Yellow Pages

Compare . . . and you'll buy

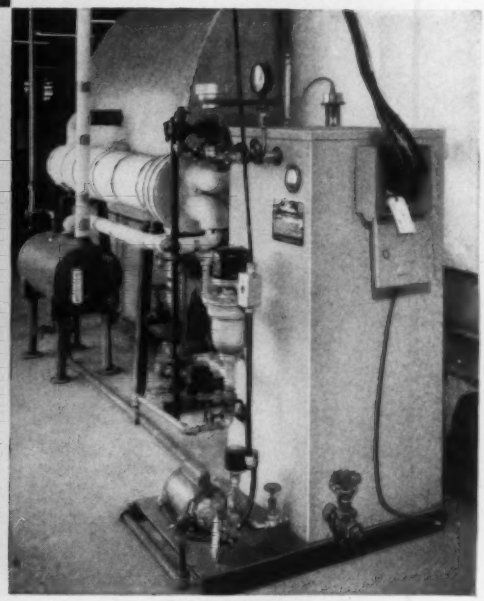
Valvair

Representatives in: Baltimore • Birmingham • Boston • Buffalo • Charleston, W. Va. • Chicago Cleveland • Cranford, N. J. • Dayton • Denver • Detroit • Eureka, Calif. • Grand Rapids Houston • Indianapolis • Kansas City, Mo. • Logansport, Ind. • Los Angeles • Louisville Miami • Milwaukee • Minneapolis • Muncie • New Orleans • New York • S. Pasadena Philadelphia • Pittsburgh • Portland, Ore. • St. Louis • Seattle • San Francisco • Syracuse Montreal • Toronto • Vancouver

Circle 585 on Inquiry Card

Pantex Speedylectric Steam Generator

Ideal Steam Source for Production Processes



Speedylectric Steam Generator supplying heat to waxer.

Manufacturing huge quantities of waxed paper containers of every size and shape, a nationally-known company needed a reliable source of heat for a production step in which the new containers are deeply impregnated with a special hot wax. Here, as in many manufacturing processes, a Pantex Speedylectric Steam Generator was the answer.

In the impregnation process, accurate control of wax temperature and submersion time is required for dimensional control of the finished product, complete wax penetration and stability of ink colors. The use of a Speedylectric Steam Generator as a heat source not only assures reliable temperature control at modest cost, but eliminates all danger of fire or explosion . . . serious hazards where the plant atmosphere is often full of particles of waxed paper.

Wherever a reliable, convenient, safe source of steam is needed, Speedylectric Steam Generators serve industry. Using a unique electrode method to generate steam, and easily portable, they require no supervision, operate without flame or fumes, and eliminate the risk of fire or explosion.

WRITE TODAY FOR COMPLETE FACTS AND FIGURES

Speedylectric Steam Jet Cleaners, too, serve industry in countless ways. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment without flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

PANTEX MANUFACTURING CORPORATION
Box 660AI, Pawtucket 3, R. I.
Send me facts and figures on:
☐ Pantex Speedylectric Steam Generators
☐ Pantex Speedylectric Steam-Jet Cleaners

Name and Title.....

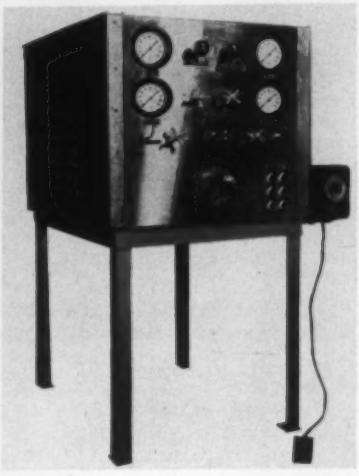
Company.....

Address.....

Circle 586 on Inquiry Card

Liquid Resin Metering

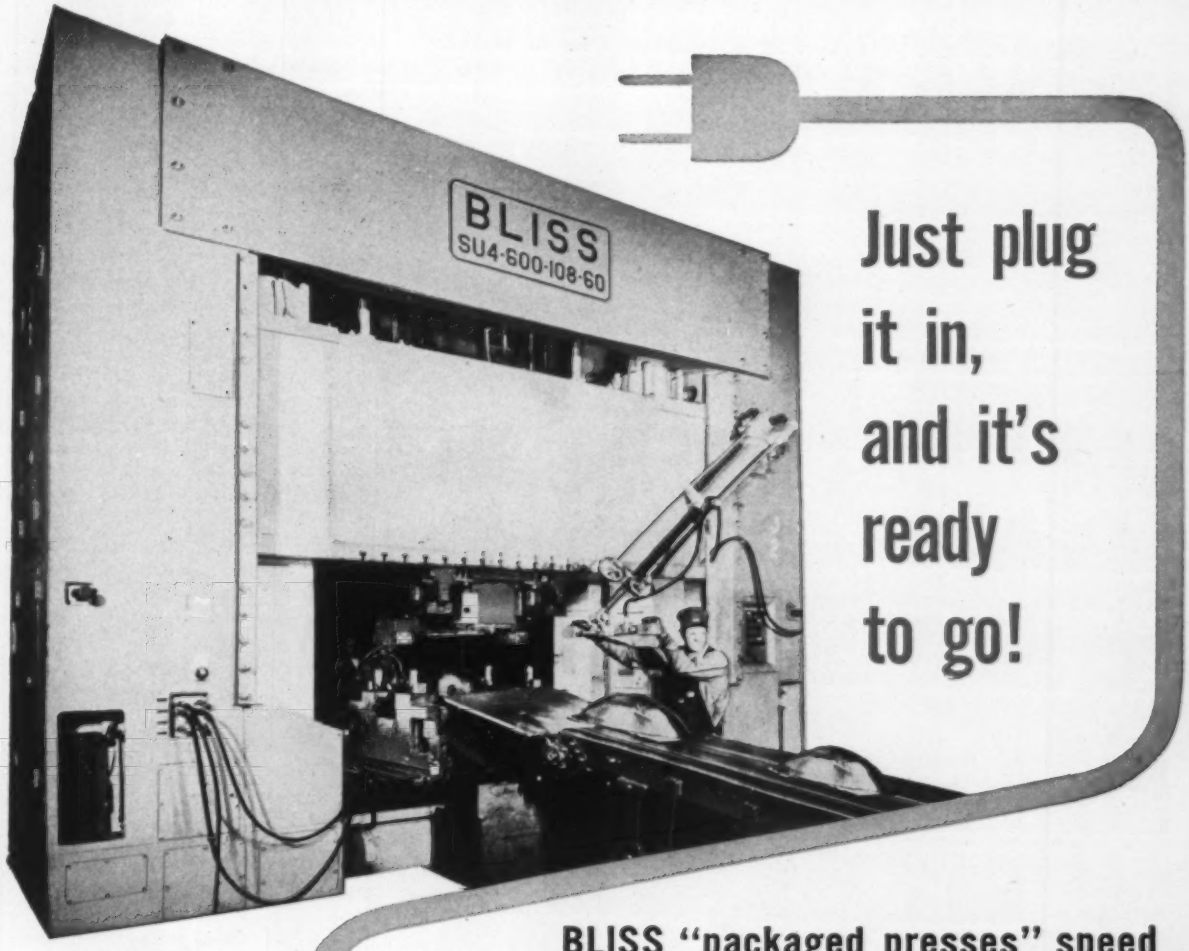
Designed for automatic proportional metering, mixing and metered dispensing of multicomponent reactive liquid resins, series #AJGU systems meet the requirements for handling formulations up to 500,000 cps. The typical two-component system (illustrated) is designed for table top mounting.



The series of systems uses a positive acting proportioning mechanism capable of maintaining volumetric measurements within ±0.5 per cent of any one component. Errors are not cumulative. Each infinite increment of material flowing through the system is maintained in the required ratio by the simultaneous proportional metering of all components. The equipment is adjustable for a wide range of ratios. Discharge metering of the mix is accomplished by adjustment of the proportional metering elements for the required combined volumetric displacement per stroke cycle as well as for ratio.

The mixer-reactor is jacketed for either heating or cooling of the mix. The mix homogeneity is assured by the continuous proportional metering of the components fed to the mixer and the high rate of shear. Cleanout of the mixer and protection against freeze-up when handling short pot life mixes is accomplished by solvent purge. **Applied Engineering Associates,** 1952 Flushing Ave., Brooklyn 37, N.Y.

Circle 420 on Inquiry Card



Just plug it in, and it's ready to go!

BLISS "packaged presses" speed installation and simplify maintenance

Automation created the problem—The dopers, kickers, lifters and other materials handling devices so popular these days brought a maze of wires and pipes in their wake. And aside from looking untidy, they slowed maintenance and proved annoying to crane operators.

"Packaging" solved it—Now, in Bliss' new line of presses, all the pipes and wires, and controls are built into the uprights. Each air and electrical line is tagged—simple to find, simple to fix. Controls are centrally located. The exterior is clean and uncluttered—cranes can move up close to change dies.

Bliss designers have come up with completely new two point and four point presses—both single action and multiple action. Design features include extremely rigid frames, eccentric drives, high speed clutches, extra long connections, motorized adjustments and many others. The entire line of presses is described in a comprehensive 32-page catalog, No. 11-B, just published. Copies for you and your staff are available by writing to E. W. Bliss Company

NEW AUTOMATION CONTROL

This new nine-station rotary limit switch will control stops, starts, interlocks, motion, time, or recycles of auxiliary equipment. Each station can be set from 0° to 360°, can be operated either normally-open or normally-closed, and is accurate within less than 1°. Write for Bulletin 33.

BLISS
SINCE 1857

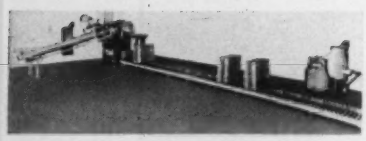
is more than a name... it's a guarantee

E. W. BLISS COMPANY, Canton, Ohio

Presses, Rolling Mills, Rolls, Special Machinery

U. S. Plants in Canton, Cleveland, Salem and Toledo, Ohio; Detroit and Hastings, Michigan; Midland and Pittsburgh, Pa.; San Jose, Calif.; *Branch Offices in* Burbank, Chicago, Cleveland, Dayton, Detroit, Indianapolis, New Haven, New York, Philadelphia, Rochester, San Jose, Salem, Toledo, Washington, D. C.; and Toronto, Ontario, Canada
E. W. Bliss (England) Ltd., Derby; E. W. Bliss Co. (Paris), France.
Other representatives throughout the world.

Circle 587 on Inquiry Card



Press-to-Press Conveyor

Designed to eliminate the need for tote boxes for storing blanks and to eliminate the continuous handling of tote boxes, Press-to-Press Automat system conveys, stacks, shuttles and stores sheet metal blanks between the blanking press and presses for secondary operations.

In operation, the sheet metal blanks from the blanking press are carried by chain conveyor to a stacker. In the stacker, the blanks fall between guides in a preload position, and are held in this position by retractable fingers which are controlled by air cylinders. These air cylinders are held open for 20 seconds, allowing from five to ten blanks to preload. During this 20-second preload interval, gates open on the stacker and the stack of blanks which had been stacked previously is pushed from the stacker to the shuttle conveyor.

Operating cycle of the stacker is controlled by the height of the stack. Normal height of each stack is between 16 and 18 inches, but can be varied to suit user's needs. When the stack height is reached, a limit switch closes, actuating the air operated gates. The gates on opening actuate a spring loaded cam on the center shuttle bar, permitting a pusher dog to push the stack from the stacker to the shuttle conveyor. When the stack reaches the shuttle, it hits another limit switch which closes the gates. The cycle then repeats for each new stack of blanks. After the stack is pushed on to the shuttle conveyor it is shuttled in steps to a position just behind the previous stack. In this position it is stored and awaits its turn to be automatically fed to the secondary presses. The shuttle conveyor is operated by a motor and a reducer mounted beside the shuttle bar which carries the pushers. Chain feed conveyor and shuttle conveyor are separately operated. **Michigan Production Engineering Co.,** 1796 E. Nine Mile Rd., Hazel Park, Mich.

Circle 421 on Inquiry Card

GEM-17 DIAL INDEX TABLE

TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY

13600 Ford Road • Dearborn, Michigan • Telephone: Tiffany 6-7573

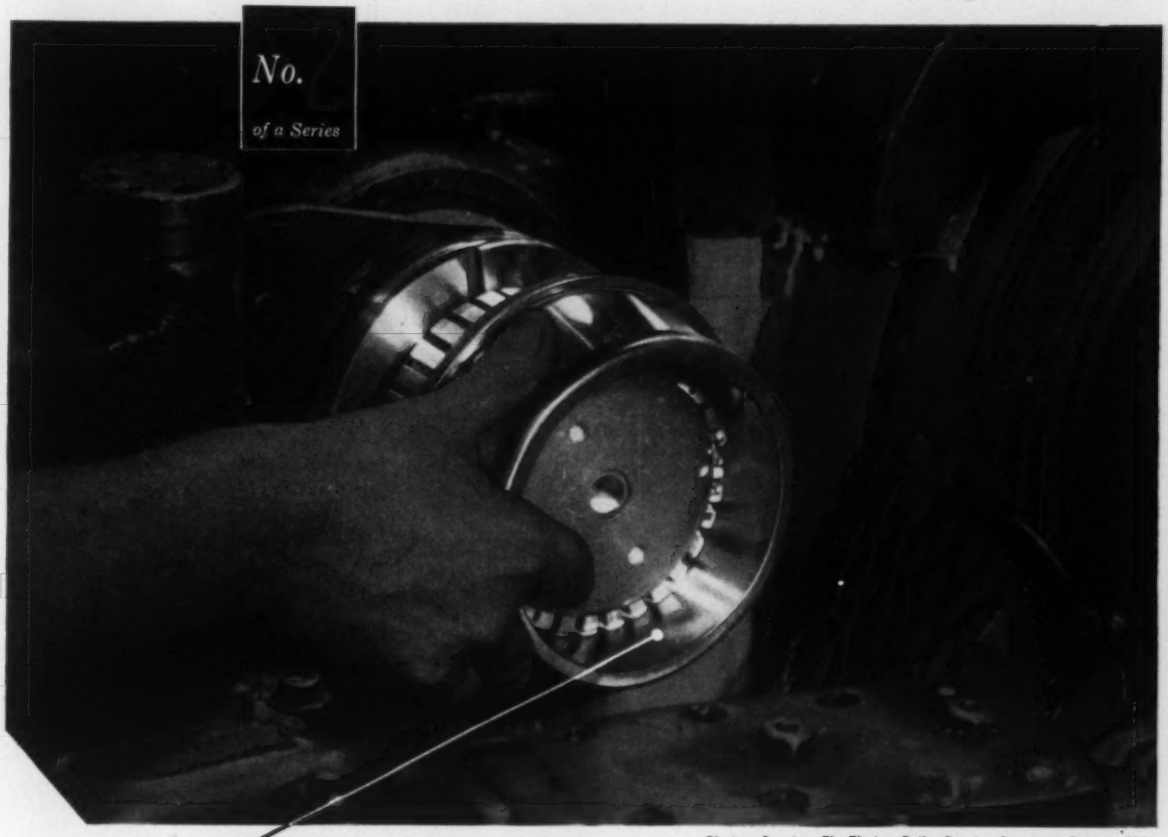
Horizontal Broaching

High speed, large surface broaching machine, developed for the precision cutting of gas turbine engine parts, has a 240-inch stroke but completes a 20-ft machining pass in less than 5 seconds at maximum speed of 300 fpm. The Electro-Gear-drive machines are available in a number of styles, 15 and 25-ton capacity, 18 or 24-inch ram face width, and with box or V-type ways. Similar models are also offered with 180-inch strokes.

Most models are equipped with phenolic lined ways for precision

Circle 588 on Inquiry Card

Erickson Precision Expanding Mandrels Solve Grinding Problems



Photos: Courtesy The Timken Roller Bearing Company, Canton, Ohio

e.g. roller bearing races

Unusual accuracy is required in the manufacture of tapered-roller bearings. That's why The Timken Roller Bearing Company, leading producer of tapered-roller bearings, uses Erickson precision expanding mandrels for rough and finish grinding of roller bearing races. For in addition to their ability to hold to closest tolerances consistently, they have instantaneous release feature that speeds loading and unloading—for real production dividends.

Let an Erickson representative show you how Erickson precision expanding mandrels can solve your grinding problems. AA-8481

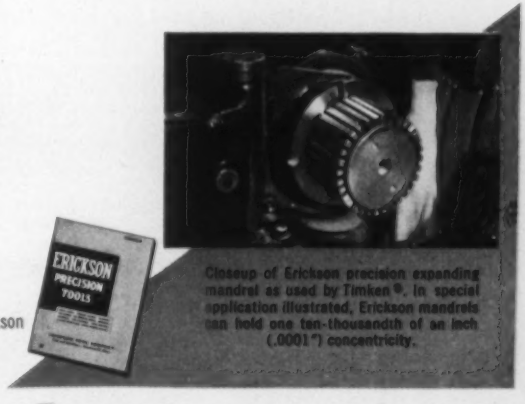
Collet Chucks
Floating Holders
Tap Chucks
Indexers

ERICKSON TOOL COMPANY

2307-3 Hamilton Avenue • Cleveland 14, Ohio

Tap Holders
Air-Operated Chucks
Expanding Mandrels
Special Holding Fixtures

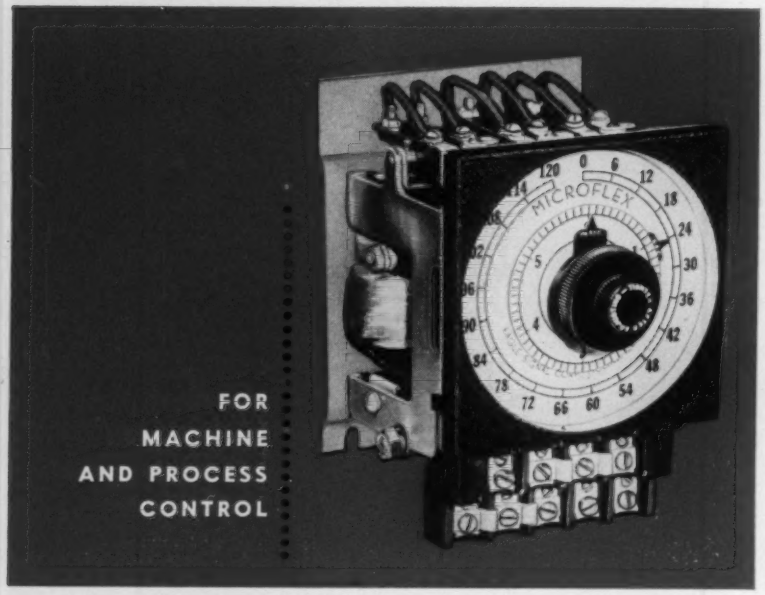
Bothered by a tough internal holding problem? Then let us show you how Erickson mandrels speed production, lower grinding costs. Call us or write for Catalog K.



Closeup of Erickson precision expanding mandrel as used by Timken®. In special application illustrated, Erickson mandrels can hold one ten-thousandth of an inch (.0001") concentricity.

Circle 589 on Inquiry Card

EAGLE
Microflex Reset Timer



Insures "20-to-1 ratio" accuracy

Time settings of pinpoint accuracy are a reality, thanks to the Microflex double dial. It takes one complete turn of the *inner* dial to advance the *outer* dial just one division. That's a 20-to-1 ratio, made possible by the patented Microflex threaded axle and pinion (see sketch). Examples of resultant accuracies are ± 1/60 of a second on a 20-second dial, and ± 1/10 of a second on a 120-second dial.

The Microflex Reset Timer is driven by a heavy-duty industrial synchronous motor. Contacts are tripped closed or open after a preset time interval. Starting and resetting are electrically controlled. Microflex offers over 150 timer operating combinations, plus a wide range of long or short time periods. It's ideal for applications like molding presses, dielectric heating, automatic mixing, die casting machines, machine tools and rubber curing.

Write for free Bulletin 110.

MAIL COUPON TODAY

EAGLE TIMERS SAVE TIME . . . SAVE MONEY

EAGLE SIGNAL CORPORATION
Industrial Timers Division
MOLINE, ILLINOIS

EAGLE SIGNAL CORPORATION A-357
Industrial Timers Division, Dept.
MOLINE, ILLINOIS

Please send free Bulletin 110 containing complete data on Microflex Reset Timers.

NAME AND TITLE

COMPANY

ADDRESS

CITY ZONE STATE

broaching jobs. All models can be made available with trunnion or horizontal shuttle tables. For two-pass broaching operations, a vertical shuttle slide is available for positioning the fixture at the end of each stroke. **Colonial Broach & Machine Co.**, Detroit 13, Mich.

Circle 422 on Inquiry Card

Enclosed Press

Used in the production of automobiles, 650-ton double-action enclosed press is floor mounted, and requires no pit or foundation for installation. The press can be moved from one place to another within the plant and be readied for work almost instantly. All electrical controls and accessory equipment are built into its frame.

The master control cabinet press air manifold, automation limit switch, automation air manifold, and terminal block cabinets are built into the press uprights and confined in dust-tight enclosures. Operator safety features include recessed door handles for the cabinets and a flush mounted control panel at the operator's station. Slide counterbalance cylinders are built-in and self-contained, eliminating the need for external surge tanks. Die lights provide illumination for the die area and are built into the inside walls of the press upright. Lubrication of all moving parts is done automatically by a central oil lubricating system. **Clearing Machine Corp., Div., U.S. Industries Inc.**, 6500 W. 65th St., Chicago 38, Ill.

Circle 423 on Inquiry Card

Special Processing?

Materials Handling?

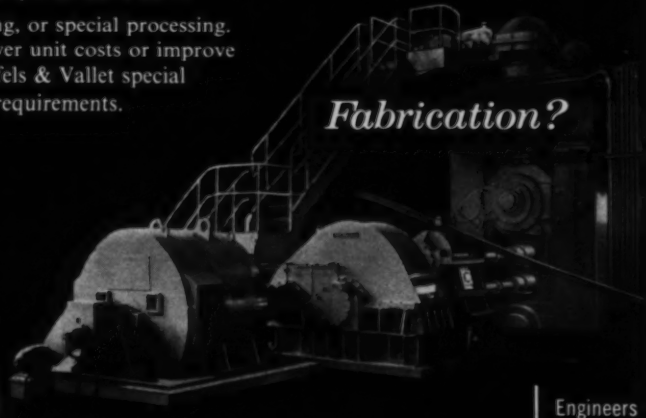
Looking for the Answer to a Tough Production Problem...

Frequently, the design of special machines will provide the answer. Helping management resolve production problems through the application of automated equipment is one of the important services offered by the Giffels & Vallet organization. This machine design service reflects years of extensive experience gained through the planning and engineering of production facilities for companies of widely diversified activity, in every area of industry. These practical insights have proved of great value in analyzing and applying solutions to problems involving special machines, mechanization, and automation.

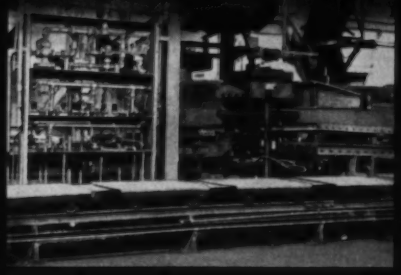
Fabrication, assembly, materials handling, or special processing. Wherever you must increase output, lower unit costs or improve product quality—the application of Giffels & Vallet special machine design services will meet your requirements.

G & V services are discussed in a special Planning Brochure. A copy will be mailed on request.

Fabrication?



Assembly?



INDUSTRIAL ENGINEERING DIVISION

Giffels & Vallet inc.

DETROIT 26, MICHIGAN New York and Houston

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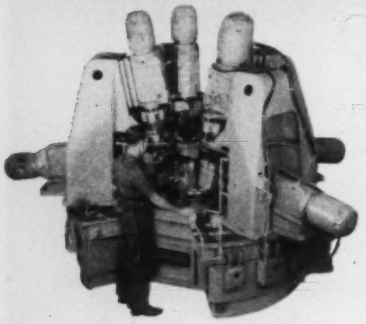
Engineers Serving Industry for Over Thirty Years

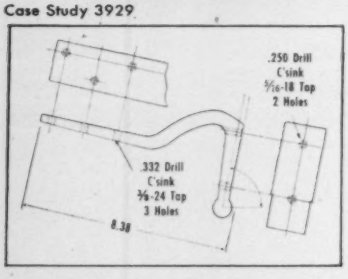
Plant Layout • Process Development • Automation Engineering • Materials Handling • Machine Design • Building Design

Two hinges drilled, countersunk and tapped every 11½ seconds ...automatically on a

KINGSBURY



Case Study 3929



620 PARTS PER HOUR GROSS

Each fixture holds two parts at the angle shown in the sketch. This allows room for four vertical units. These units operate on the three parallel holes. Four angular units operate on the two parallel holes. Two-step drilling shortens the time cycle and increases the production rate. The operator unloads a finished part, loads a rough one and pushes a button to index the table. After the table indexes, all units operate automatically.

All Kingsbury machines are completely tooled and ready to produce. We run test samples and ship them to you for your approval before we ship the machine. For high production drilling and tapping, a Kingsbury is the best machine you can buy. Kingsbury Machine Tool Corporation, Keene, N. H.

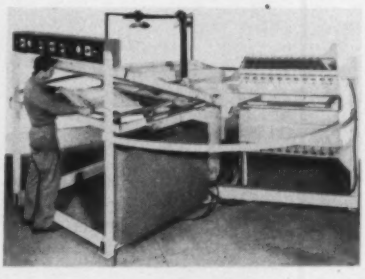
KINGSBURY
INDEXING AUTOMATICS
for high production drilling and tapping

104 Circle 592 on Inquiry Card

Pneumatic-Tired Truck

High maneuverability due to short turning radius and power steering, provision for optional dual or single-drive wheels, and a powerful engine for the demands of outdoor work are features of gas-powered, pneumatic-tired fork lift truck. Designated Model FGF-40, the 4000-lb truck has an overall length of 85¾ inches, with a turning radius of only 79 inches. Capacity is 4000 lb at 24-inch load center. The engine has 48.2 hp. Other features of the truck include a Timken power axle, a Baker oscillating rear axle, a loaded travel speed of 9.5 mph, hydraulic brakes, and two speeds forward and two speeds in reverse. **Baker - Raulang Co.**, Box 5579, Cleveland 1, O.

Circle 424 on Inquiry Card

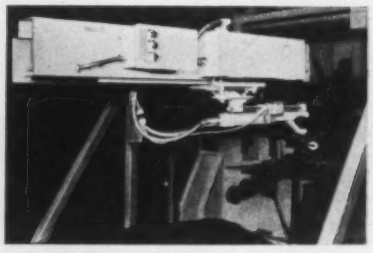


Vacuum Forming

Available for multistation feeding, completely automatic operation, and in various platen sizes, vacuum forming machine features high production rates from a continuous roll fed operation. Illustrated model is for single-station feeding and semiautomatic operation, with a platen size of 20 by 25 inches.

Used for skin packing, blister packing and a visual packaging process called Snap-Pak, the machine is equally applicable for high rate production of items up to 5 inches high, from thermoplastic sheets ranging from 0.002 to 0.125-inch thickness. Visual packaging has been applied successfully to such items as food, cosmetics, drug items, toiletries, hardware, etc. **Auto-Vac Co.**, 1985 State St. Ext., Bridgeport, Conn.

Circle 425 on Inquiry Card



Press Unloader

Adaptable to all types of metal forming and forging presses, air-powered, heavy duty automatic straight line press unloader is a self-contained package type that unloads sheet metal panels or forgings from presses. The unloader operates on 50 psi air pressure with minimum air consumption. The press unloader is supported by either portable or fixed frame mountings which can be made in standard designs to suit particular requirements. When installed on a press, the unloader requires no guards, provides access for easy die setting, does not interfere with crane chains and will unload draw dies on the binder angle.

Speed and stroke adjustments as well as all dimensional adjustments of the unloader unit can be made from floor level. The electrical control panel of the unloader includes an indicator light, a selector switch that enables the unloader to be operated manually or automatically, and a single-stroke pushbutton control that facilitates die setup. An air pressure gage, visible when the unit is in operation, is provided in the pneumatic

Askania Regulator Company NEWS

Automatic Controls for

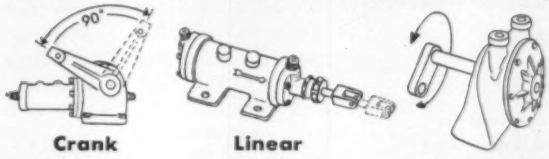
FLOW, PRESSURE, RATIO, COMBUSTION, EDGE POSITION AND THICKNESS

ELECTROJET® PROVIDES ½ H.P. TO 40 H.P. HYDRAULIC OUTPUT FROM LOW LEVEL ELECTRICAL INPUT

FROM TRANSDUCERS:

FOR PRESSURE • FLOW • RATIO • WEIGHT OR FORCE • SPEED • POSITION • TEMPERATURE • THICKNESS

TO THESE FINAL CONTROL ACTIONS:



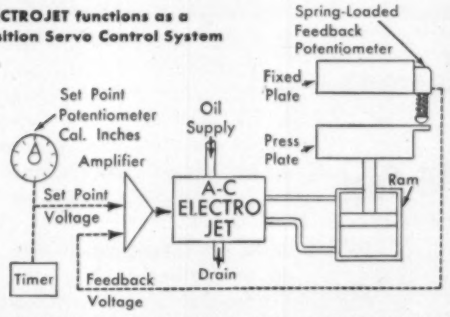
Crank Moment **Linear Motion** **Rotation**

Note the Unique Advantages

The ELECTROJET offers those particular advantages only hydraulic power can provide:

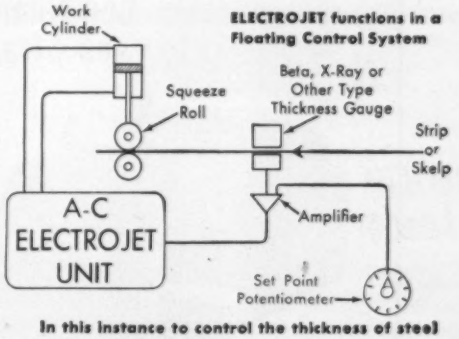
1. Low Maintenance—Self Lubricated Parts
2. Output Power to Fill Needs from Smallest to Largest Requirements
3. Wide Range of Operating Speeds
4. Low Time Constants
5. High Acceleration and Damping Power
6. Convenient Safety Interlocks

ELECTROJET functions as a Position Servo Control System



In this instance to control the thickness of the sheet felt being produced on an hydraulic press.

ELECTROJET functions in a Floating Control System



In this instance to control the thickness of steel strip in a Rolling Mill

STUDY THESE SPECIFICATIONS

A-C ELECTROJET

Reference winding (constant).....115v, 0.15 amp, 50-60 cps
Control winding (variable).....0-115v, 0-0.15 amp
Break-loose voltage.....2v max.
Jet Pipe pressure.....110-150 psi std, 400 psi max.
Jet Pipe flow (examples)...1.2 mm nozzles; 100 psi, 0.6 gpm
2.5 mm nozzle; 400 psi, 5.2 gpm
Booster pressure.....2000 psi max.

D-C ELECTROJET

Maximum power input.....6 watts
Coil resistance.....5 ohms to 20,000 ohms
Break-loose power.....20 microwatts
Hydraulic specifications.....As for A-C Electrojet

Amplifiers for both A-C and D-C Electrojets are available to meet almost all requirements. However, in most applications the D-C Electrojet requires no amplifier.

Send for application bulletin No. 38.1

THE ASKANIA REGULATOR COMPANY APPLICATION BULLETIN NO. 38.1 contains
16 diagrams and illustrations to describe
1 available ELECTROJET types
2 applications and operation factors
3 types of Final Control elements, etc.

You'll want this bulletin for application... for study....for ready reference.

Write Askania Regulator Company, 244 E. Ontario Street, Chicago 11, Illinois

***ASKANIA* REGULATOR COMPANY**

"CONTROLS FOR INDUSTRY"

HYDRAULIC, ELECTRONIC CONTROLS & SERVOS, GENERAL SYSTEMS, ENGINEERING & COMPUTER SERVICE, VALVE ACTUATORS & CYLINDERS

A SUBSIDIARY OF GPE

Circle 593 on Inquiry Card

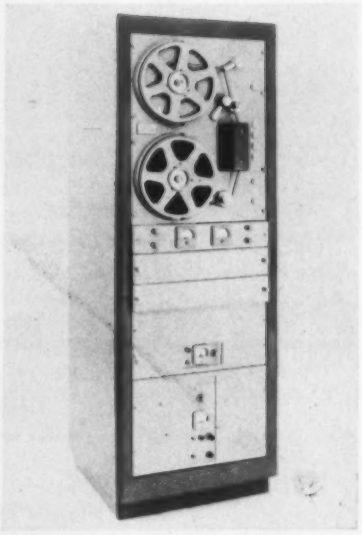
control panel along with a conventional oiler, filter and regulator. The carriage which moves the jaw assembly back and forth on a ground guide bar, is actuated by the power cylinder through a hardened gear and rack assembly.

In operation, the jaws in the jaw assembly, which is bolted adjustably to the carriage, advance into the die area and grip the sheet metal panel. The carriage is then moved to the rear. The jaws next open and retract, releasing the panel for the next stamping operation. Finally, the carriage advances to start position for the unloading of the next panel. **Press Automation Systems Inc.**, 18616 Wyoming Ave., Detroit 21, Mich.

Circle 426 on Inquiry Card

Tape Recorders

Modular electronic assemblies and tape transport design improvements have been included for greater flexibility and accuracy in FR1100 series of instrumentation



tape recorders. Intended for all instrumentation recording applications not requiring the extreme precision of the Ampex FR100 recorder, the unit supplants Models 303, 306 and 307 recorders. In addition to increased flexibility and accuracy, the new equipment has provisions for complete remote control, compatibility with other Ampex recording equipment and simplified maintenance.

From one to seven tracks of data may be recorded and reproduced at four tape speeds. Plug-in record and reproduce amplifiers provide quick interchange between direct, frequency modulation and pulse width modulation recording modes. Record and reproduce heads are compatible with all three modes, eliminating head changes when switching from one method to another.

Frequency response extends from dc to 100 kc. Direct recording may be used from 300 cycles to 100 kc, and the dc to 10,000 cycle range may be recorded with frequency modulation methods. **Instrumentation Div., Ampex Corp.**, 934 Charter St., Redwood City, Calif.

Circle 427 on Inquiry Card

Electric Typewriter

Designed for use as an input and output device for the data processing field, electric typewriter automatically types at a rate of 120 words per minute. It can be used in conjunction with computers as well as with measuring and recording instruments, scales, and

Sesco
INC.
8881 Central
Detroit 4, Mich.
Original
Punch Press Gripper Feed
Pinch Gripping Assures Scuff-Free Feeding
Sesco coil handling equipment is completely powered at a controlled rate to customer specifications
Cradle or Straightener available as separate units
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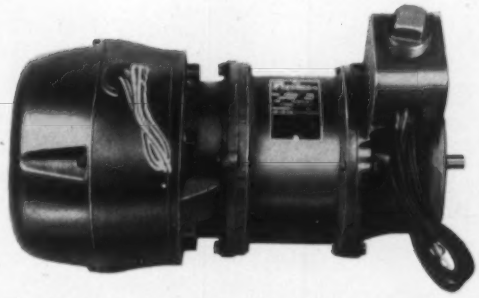
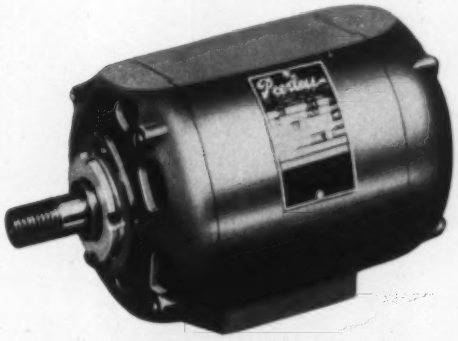
It's a real production booster
Centering Reel
The first of its kind
TWIN-IN ACTION coil handler
Sesco's broad experience enables its staff to render assisting services in the handling of coils and parts for the metal stamping industry
Write for Catalog or Visit our Plant
engineers & manufacturers of machine tools and press room equipment

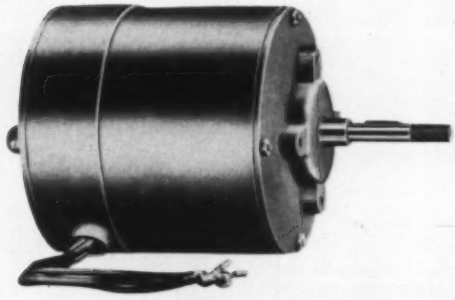
Circle 594 on Inquiry Card



EXPLOSION-PROOF TORQUE MOTOR WITH BRAKE



COMPACT DESIGN RADIAL SAW MOTOR



NAVY MOTOR—SPRAY-TIGHT

SPECIAL MOUNTED VERTICAL MOTOR

If stock motors cut machine efficiency see Peerless.

Peerless builds a complete line of general purpose motors as well as hundreds of specials designed to meet specific needs. Our engineers have wide experience in applications of all types, and specialize in solving motor problems for design engineers who require unusual mountings or unusual construction to achieve maximum machine efficiency. Consult your nearby Peerless representative or write directly to us about any motor problem. We'll work with you to develop the one motor that powers your equipment best. Write for Bulletin SDA-155 now.

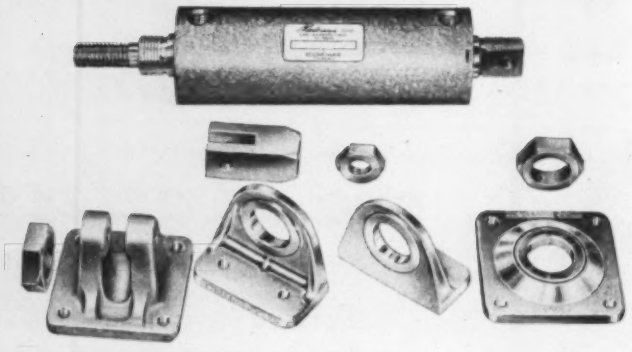
Single phase
½ thru 7½ HP

Polyphase
½ thru 30 HP

ELECTRIC MOTOR DIVISION
THE *Peerless-Electric*® COMPANY
FANS • BLOWERS • MOTORS • ELECTRONIC EQUIPMENT
1512 W. MARKET ST. • WARREN, OHIO

Modernair ECONOMAIR CYLINDERS

Now in 5 Bore Sizes!



TWO NEW BORE SIZES—1 ½" and 4" now added to present 1 ⅛", 2" and 3" bores; for air or hydraulic service to 200 p.s.i.

COMPACT—internal feed-ring locking of heads to cylinder barrels eliminates bulky head castings.

INTERCHANGEABLE MOUNTING BRACKETS—flange, L-type, clevis mountings fully interchangeable for any desired arrangement without costly specials.

NON-CORROSIVE CONSTRUCTION—barrels of seamless hard-drawn brass tubing, rods of ground and polished stainless steel, heads and piston of aluminum—with reliable, job-proved industrial "O" ring sealing throughout.

CUSHION OR NON-CUSHION STANDARD TYPES.

NEW AUDIO-VISUAL FLUID POWER TRAINING AIDS AVAILABLE

Sound and color movies, slide presentations, and new PORTO-MOBILE training display now available for plant meetings, etc. No obligation; call your local MODERNAIR sales outlet (see listing in Yellow Section of your phone book) or write us for arrangements.

ECONOMAIR series cylinders offer today's best buy in quality cylinders at truly competitive prices—why pay more and get less? Write today for complete specifications, prices.

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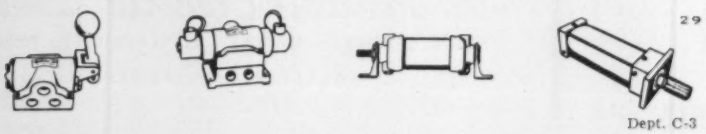
SAN LEANDRO, CALIFORNIA

MEMBER OF NATIONAL FLUID POWER ASSOCIATION



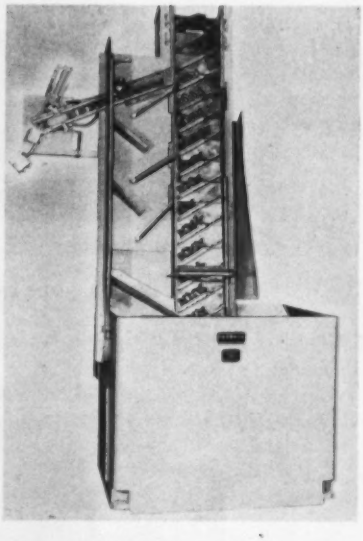
29

Dept. C-3

meters in such applications as engine testing, liquid flow through pipelines, production control, wind tunnel research, etc., to provide a visual record.

The input-output typewriter is operated by a series of electromagnets and solenoids mounted beneath the keyboard. The magnets and solenoids act as receivers of signals transmitted from the controlling device, or computer, and automatically actuate keyboard functions of the typewriter, including carriage return, spacing, tabulation, ribbon color control, etc. When used as an input device, electrical impulses are transmitted from the typewriter by merely depressing a key. **Electric Typewriter Div., International Business Machines Corp.,** 590 Madison Ave., New York 22, N.Y.

Circle 428 on Inquiry Card

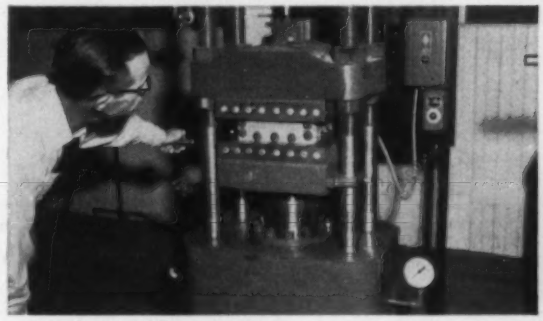


Joint Spider Feeder

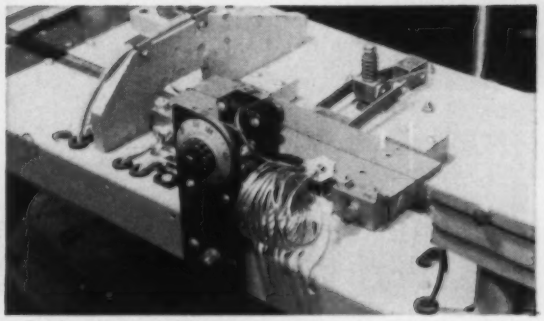
Designed to automatically feed universal joint spiders to a special Landis centerless grinder where all four diameters are ground in one operation, feeder is a modification of Model 2500. In operation, parts are placed in the

CHROMALOX Electric Cartridge Heaters

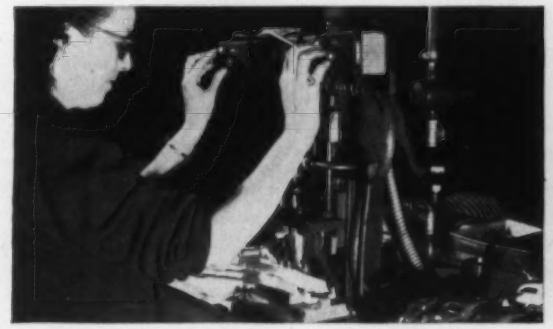
. . . compact, self-contained heat for your production equipment



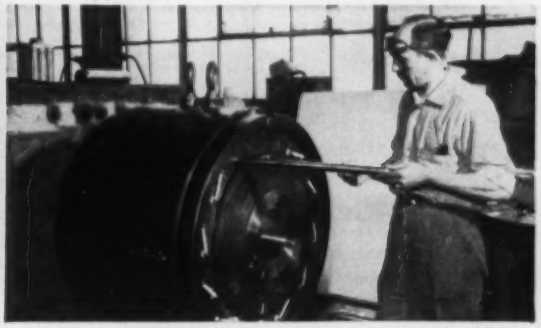
Plastics molding press—Thermostat accurately measures out the exact temperatures needed in one press or a dozen—a different heat for every press if necessary.



Packaging machine—Controlled heat in each of two platens tightly seals food product in plastic bags. Thermostatic control provides 160°F maximum heat for positive seal without danger of burning plastic.



Pneumatic Press—Heaters installed in steel block feed heat to integral copper tips that quickly and accurately "mushroom" projections holding windows in plastic toy autos.



Extrusion press—Easily installed heaters keep billets at 1000°F to provide proper flow . . . provide uniform temperature; constant, accurate control; rapid heat-up with minimum radiation loss.

When you install Chromalox Electric Cartridge Heaters, you get the many advantages that only electric heat can provide. Low initial cost; quick and easy installation; long, maintenance-free heater life. Instant heat-up. Accurately maintained temperatures to 1000°F controlled at each machine. No pipes, valves or flues. No flames or fumes. Cool working area.

There is a Chromalox Electric Cartridge Heater for every spot heating job. Lengths to 40 inches; diameters of ⅜ inch to 3½ inches. Ratings from 30 to 8750 watts, with terminal and lead wire styles for every type connection and application.

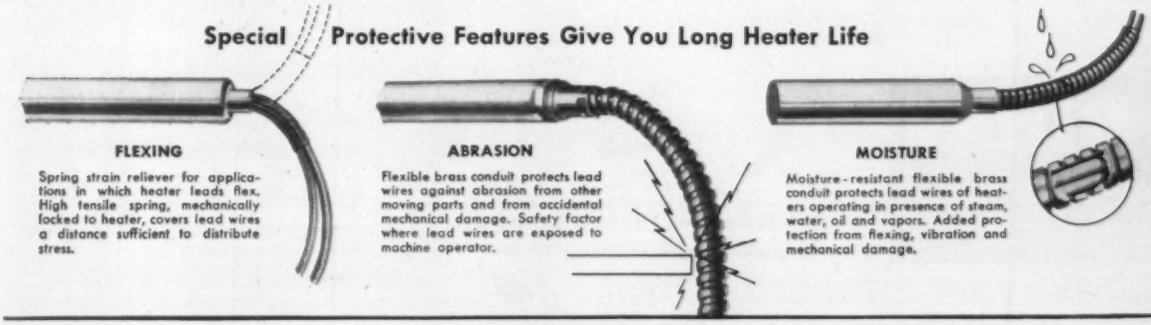
For the full story, call your Chromalox Representative, or, write today for Bulletin 850.

Edwin L. Wiegand Company

7850 Thomas Boulevard • Pittsburgh 8, Pa.

B-717A

Special Protective Features Give You Long Heater Life



FLEXING

Spring strain reliever for applications in which heater leads flex. High tensile spring, mechanically locked to heater, covers lead wires a distance sufficient to distribute stress.

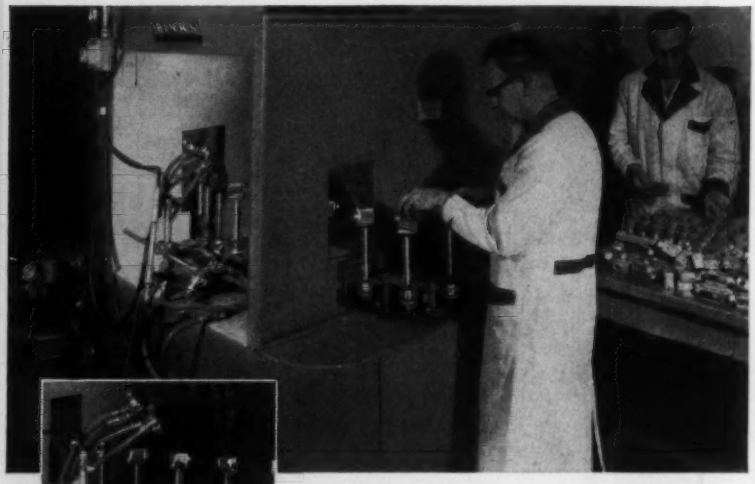
ABRASION

Flexible brass conduit protects lead wires against abrasion from other moving parts and from accidental mechanical damage. Safety factor where lead wires are exposed to machine operator.

MOISTURE

Moisture-resistant flexible brass conduit protects lead wires of heaters operating in presence of steam, water, oil and vapors. Added protection from flexing, vibration and mechanical damage.

Circle 597 on Inquiry Card



Switch housings are placed on conveyorized spindles, automatically spray finished, air dried and removed.

Each switch housing is uniformly painted by Model 21 pneumatically operated Binks spray guns.

A Binks automatic spraying machine at MICRO SWITCH...

"paid for itself in three months ...boosted finishing output 400%"

"We are now able to paint up to 945 switch housings an hour," reports Mr. Walter Gage, finishing foreman for the MICRO SWITCH division of Minneapolis Honeywell Regulator Company, Freeport, Ill. "This is four times our previous hand spraying rate and we use one-third the manpower."

Fast, uniform finishing

Switch housings are placed on conveyorized spindles which rotate as they pass through the spray booth. Binks pneumatically operated Model 21 automatic spray guns apply a uniform coating on all surfaces as each spindle passes.

Engineering help available

Working with your engineers and production people, Binks spray finishing engineers can help you cut costs...boost production...improve quality. Because Binks line of spray finishing equipment is so complete, they need not compromise in the selection of any part of a finishing system. The "right" equipment combination for your every production need, is always available.

For complete information

Contact your nearest Binks Branch Office or write direct to the address below.

Ask about our spray painting school
Open to all...NO TUITION...covers all phases.

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Binks
EVERYTHING FOR SPRAY PAINTING

SPRAY GUNS

AIR COMPRESSORS

SPRAY BOOTHS

Binks Manufacturing Company
3132-40 Carroll Ave., Chicago 12, Ill.

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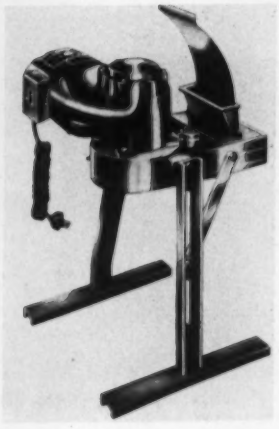
Circle 598 on Inquiry Card

9 cu ft capacity hopper from which they are taken by the elevating conveyor to the delivery chute. Then, properly oriented, they are delivered to the grinder. **Feedall Inc.**, Willoughby, O.

Circle 429 on Inquiry Card



Scrap Chopper

Press room accessory is designed to solve the problem of what to do with coil and strip stock scrap immediately after stamping. The scrap chopper is well suited for use in an automatic press setup. The unit takes scrap stock feeding from the press, and by an orbital shearing action of hardened steel blades, chops it into a size easily and economically stored for collection. The chopper may be tipped at any angle to suit feeding material.

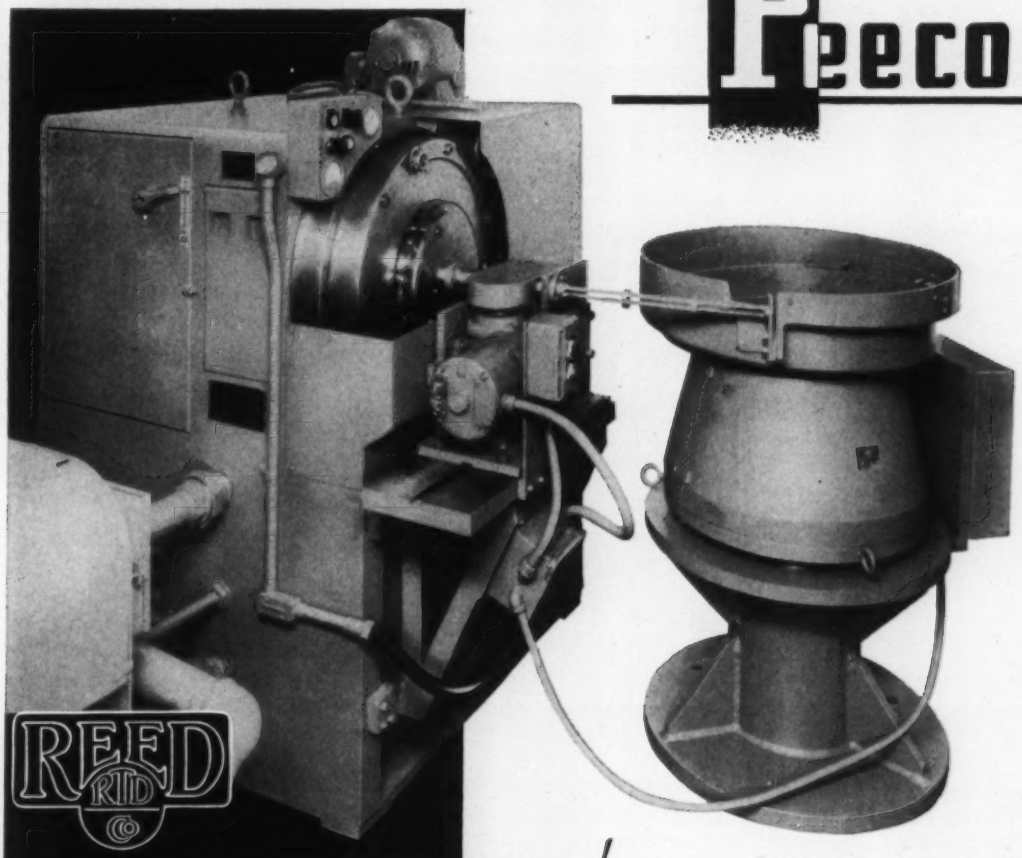
The chute through which material passes to cutting blades has a reciprocating action which prevents the stock from hanging up, and keeps it feeding freely. Cutting blades are $\frac{3}{8}$-inch thick, ground on one surface only, are self-aligning, and can be reground down to half the original thickness and still be used.

The cutting action allows equal opening at each end of the cutting blades, thus permitting free entrance of material through the blades. Stock too thick that is accidentally fed between blades, simply stalls the unit without danger of breakage to any parts. The motor is heater protected. Equipment has lubrication fittings located at all necessary points. **Cooper Weymouth Inc.**, 600 Honeyspot Rd., Stratford, Conn.

Circle 430 on Inquiry Card

PRODUCTION EQUIPMENT

produces MORE with Peeco



REED ROLLED THREAD DIE CO.
production equipment *Now* includes
DEVELOPED Peeco FEEDERS

The PEECO Vibratory Parts Feeder (Model 25) pictured here is the feeding mechanism which supplies a continuous flow of blanks for the A23 Reed Thread Rolling Machine. Production rate of this machine for rolling high pressure stud threads varies from 70 inches (and up) per minute, depending upon the outside diameter of the blank and the number of threads per inch to be rolled.

Peeco

As a leader in the field of vibratory parts feeders PEECO is contributing its share towards the greater capacities being achieved by new production equipment. We are glad to include, among the companies in this field now being served by PEECO, the Reed Rolled Thread Die Co. of Holden, Massachusetts, specialists in thread and form rolling tools and equipment.

If you want to produce more, send for bulletin # 536 and ask for the name of the PEECO representative in your area.

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF VIBRATORY PARTS FEEDERS

PERRY EQUIPMENT & ENGINEERING CO.

ERIE, PA. • • • DIVISION OF AUTOMATION DEVICES, INC.

Circle 599 on Inquiry Card

. . . in relay systems check what NORTH ELECTRIC can do for you

ENGINEERING CIRCUIT DESIGN
COMPONENT SELECTION
PRECISION PRODUCTION
FABRICATION AND ASSEMBLY
TESTING

Product developments, commercial and military, that necessitate extensive engineering and production in the areas of complex relay switching and control systems need not become expensive headaches.

Over 70 years' experience in the design, engineering, development, and manufacture of those components and component assemblies embodying relay systems, have given NORTH a wealth of background and know-how that is immediately available to you.

NORTH's specialization in this field puts at your disposal the engineering, design, and production talents of a "specialist team."

Let NORTH assist you — from the very beginning — in the design, engineering, component selection, and production of relay switching and control systems to your specifications.

INDUSTRIAL DIVISION

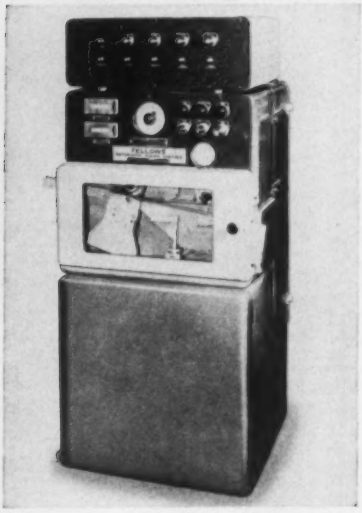
NORTH ELECTRIC COMPANY

723 SOUTH MARKET STREET • GALION, OHIO

Circle 600 on Inquiry Card

Pinion Checker

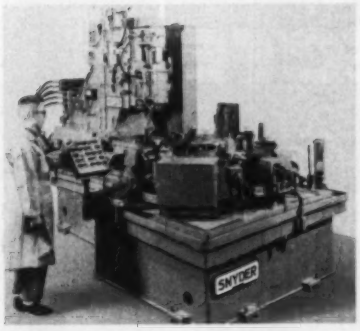
Designed to automatically inspect gear pinions for quality, to indicate excessive errors and to sort gears which are outside predetermined limits, automatic pinion checker can be included in an automated production line to monitor the machine cutting or finishing the gear pinions. Should the monitored machine produce three rejects consecutively, the automatic pinion checker signals the machine to stop. In addition to this, a percentage control system watches the machine output and, should it produce more than a preset percentage of rejects, the pinion checker will signal the machine to stop.



The method of inspection is based on the principle that errors in gear tooth elements cause variations in center distance between the pinion and the master gear as the two rotate in intimate contact. The instrument translates change in center distance into three types of errors: integrated size check, over and under; total composite error; and maximum tooth to tooth error. Should any of these measurements exceed preset limits, a light will indicate the type of error during the measuring cycle and sorting gates will be set to pass the gear into either the OK, the undersize or the oversize chute. All salvageable rejected gears go in the oversize chute and all other rejects go through the undersize chute. A dial indicator is provided for visual inspection and for ease

in setting tolerances. **Fellows Gear Shaper Co.**, Springfield, Vt.

Circle 431 on Inquiry Card

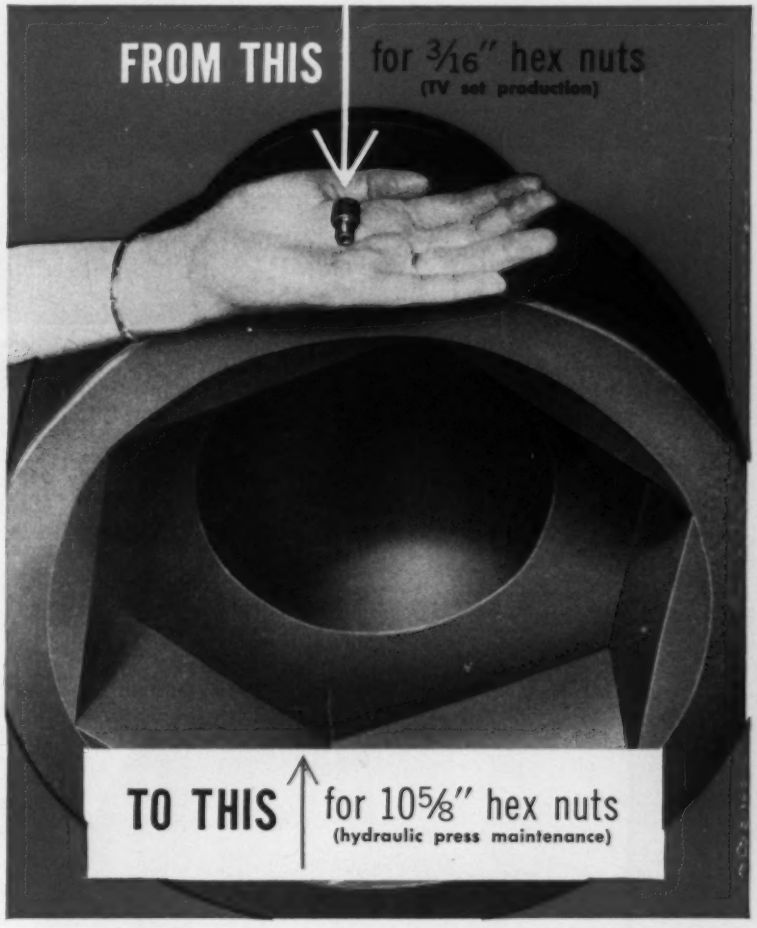


Milling Machine

Five complex milling operations with minimum tool changes and part handling are performed on workpiece with low production requirements by machine which incorporates special controls and drives. Basically the machine consists of a welded steel T-shaped base on which are mounted a 40-inch diameter rotary table and a horizontal slide unit carrying a vertical spindle. Table speed, vertical cutter travel and horizontal slide travel are controlled by stops mounted on the table periphery. It is possible to provide a variety of cutter locations, interrupt cuts and change table speeds by suitable stop locations. Cutter speeds are adjusted to tachometer settings by a variable speed drive. Tool changes are simplified by a quick-change collet type holder. Tool setting gages are built into the work fixture that is mounted on the rotary table.

The illustrated machine mills bosses and performs four blend-milling operations on a large magnesium aircraft jet engine front bearing support. The cutter is automatically lifted or backed out to clear spokes or interrupt cuts in the various operations. Table speeds are automatically increased for rotation between milling cuts. The five operations are performed with the part in two different loading positions using three different milling cutters. **Snyder Tool & Engineering Co.**, 3400 E. Lafayette, Detroit 7, Mich.

Circle 432 on Inquiry Card



Illustrating the smallest and the largest Apex impact sockets proves only that you can get an Apex socket to run any size of hex nuts you may be using on your production or maintenance work.

These extremes of socket size do not show the precision machining of the high carbon electric furnace alloy steel used in Apex sockets. Nor do they show the cold broaching and carefully controlled heat treating that enables Apex sockets to withstand the severe shocks and strains of heavy-duty service.

But you can easily prove that Apex impact sockets will outperform and outlast ordinary sockets. Just try Apex impact sockets on your work—you'll soon see that freedom from quick wear-out and breakage will help boost productive output per tool and, at the same time, help lower your tool costs.

Catalog 29-R lists over 5,000 types and sizes of Apex Nut Running Tools; write, on your company letterhead please, for your copy.

DIFFICULT FASTENING PROBLEM?
Send sketch or blueprint, we'll quote promptly

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PHILADELPHIA • PITTSBURGH • PROVIDENCE • ROCKFORD • ST. LOUIS • SEATTLE
SHREVEPORT • SOUTH BEND • SYRACUSE • WICHITA

Circle 601 on Inquiry Card

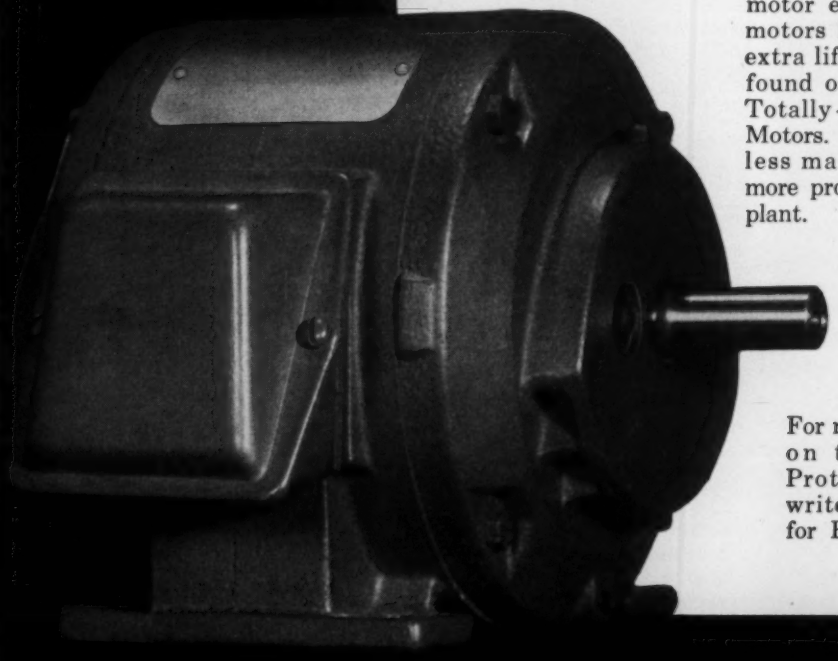
the world's only

TOTALLY-PROTECTED MOTOR

When we speak of Totally-Protected, we mean superior frame design with rigidity for heavy load conditions. We mean Metermatic bearing lubrication, acid and oil-proof insulation system, and motor leads, labeled and sealed in neoprene.

Totally-Protected means all this and more, but most of all it means a new concept of motor design and construction.

This Totally-Protected concept brings you a new motor efficiency. These motors have a built-in extra life—an extra life found only in Reliance Totally-Protected A-c. Motors. You profit from less maintenance and more production in your plant.



For more information on this Totally-Protected concept, write to Dept.263A for Bulletin B-2401.
(B-1543)

RELIANCE R ELECTRIC

AND ENGINEERING COMPANY

CLEVELAND 17, OHIO · CANADIAN DIVISION: WELLAND, ONT.
Sales Offices and Distributors in Principal Cities

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

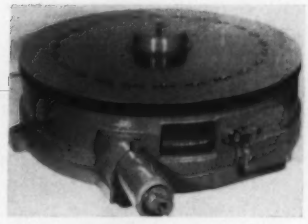
For detailed information and literature, use card page 17

Pushbutton Units

Line of oil-tight, pushbutton control units includes two additions called the Roto-Push and Pres-Test. The functions of a single-button station are combined with the advantages of a two or three-position selector switch in the Roto-Push unit. The circuit desired is selected by rotating the knurled guard ring to the desired function and actuated by depressing the button. *Run-Safe-Jog* functions, for example, instead of requiring three separate units, are combined in one. Six cam selections are used with the blocks for two-position operators; two selections are used for three-position units.

The Pres-Test indicating light provides a simple means of checking indicating light bulbs without disturbing the control circuit and without removing a lens or bulb—a depression of the lens is all that is required. A single-pole, double-throw momentary contact switch is built into the unit. The normally closed position of the switch is on the standard circuit; the normally open position is on a separate, constantly energized momentary contact circuit. Pres-Test line of oil-tight units offers a back-of-panel depth of only 1 23/32-inch for the transformer types and 1⅞-inch for the resistor units. **Cutler-Hammer Inc.**, 378 N. 12th St., Milwaukee, Wis.

Circle 433 on Inquiry Card



Index Table

Capable of handling dial plates up to 36 inches in diameter, PDC-AM24 Geneva motion index table is a series with from 16 to 36 stations. Standard dial plate is 24 inches in diameter, with a total thickness of approximately 6 inches. The unit is powered with a start and stop rotary air motor drive that indexes in one second and locks accurately to ±0.001 at the 24-inch diameter with a positive rolling lock, carrying a load of 1000 lb.

The table includes a rotary air motor, limit switch, solenoid valve, air line filter, air line oiler, and covered box with three interlocking control relays. **Precision Detroit Co.**, 20100 Sherwood Ave., Detroit 34, Mich.

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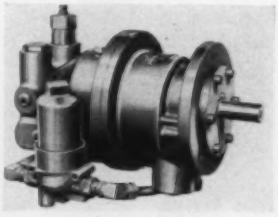


Fluid Power Pump

Well suited for use on diecasting machines, large injection molding presses, double-acting or four-way differential presses, calendar hold-downs or similar equipment involving high static loads over long periods under adverse conditions, constant displacement pump is designed for heavy duty, continuous 3000 to 5000 psi operations requiring 3 to 10 hp. Capacities at 3000 psi range from 233 to 1090 cubic inches per minute, depending on the size and rpm of the driving motor.

Illustrated pump is equipped with a Purolator type micronic filter designated HG. This design provides filtration and cleaning of the hydraulic fluid before entrance to the high pressure axial piston end, and continues on to the operating cylinder or accumulator. One-piece, alloy steel, axial rolling pistons and balanced flat (port) valves are incorporated into the pump. **Oilgear Co.**, 1560 W. Pierce St., Milwaukee 4, Wis.

Circle 435 on Inquiry Card

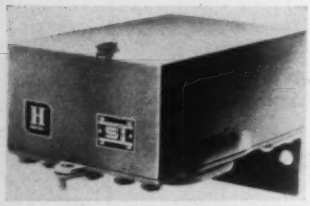
Quick Disconnect

Designed to allow fast disconnection of pressurized pneumatic lines up to 3000 psi, high pressure disconnect features safe operation. With the handle in upright position (illustrated), an integral floating ball-seat valve is fully open. To disconnect the line, the handle is rotated 90 degrees down. During this 90-degree movement, the valve closes and, simultaneous-

ly, the pressure downstream from the valve seal is automatically bled out, allowing the line to be separated without any danger.

The fitting at the downstream end cannot be removed while the valve is in the open position, nor can the valve be put into the open position with the downstream fitting disengaged. A high flow factor is obtained by an unobstructed, straight through flow path, with constant cross-section area. The device has guaranteed zero leakage under all operating pressures up to 3000 psi. Ambient and operating temperatures are from −65 to 200F. The disconnect is available in right angle or straight through configuration. Available line sizes include ¼, ⅜, and ½-inch. **Hydromatics Inc.**, Cedar Grove, N.J.

Circle 436 on Inquiry Card

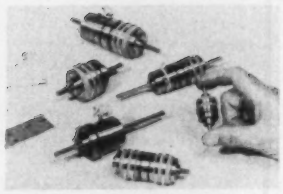


Signal Converter

Developed for use in pneumatic measurement or control circuits for a variety of purposes, computing device is called the Sorteberg Force Bridge. The unit can convert a transmitted signal from a square root flow transmitter into a linear signal, permitting the use of a flow receiver with an evenly graduated chart.

The converter can be used to maintain a ratio between two pneumatic signals for flow ratio control. It can also be used to multiply, subtract, divide or square pneumatic outputs, or to provide pressure and temperature compensation for transmitted flow signals. Design of the Force Bridge assures friction-free operation by the use of a feedback principle in a weigh beam and fulcrum system. Principal components are of plug-in construction, housed in a die-cast case. **Industrial Div., Minneapolis-Honeywell Regulator Co.**, Wayne & Windrim Aves., Philadelphia 44, Pa.

Circle 437 on Inquiry Card

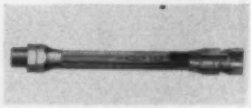


Clutches and Brakes

Developed for applications in the telephone, electronics, instrumentation, oil, chemical, precision tools and aircraft industries, line of miniature and small electric clutches and brakes is available in five styles and six sizes. The devices bring automatic control to the miniature and small electric clutch and brake field, allowing all functions of a machine or group of machines to be controlled completely through design of electrical circuits, and affording automatic remote control of a series of operations through single units or a combination of units.

A feature of the units is the elimination of gears, cams, levers, etc. A flexing diaphragm eliminates sliding parts. The diaphragm pulls the armature to center when in de-energized condition. The drive, coupled to the clutch, rotates the housing while the shaft, keyed to the armature, is stationary. When energized by current through slip rings, the clutch coil effects mechanical coupling with the armature. The brake housing applies negative torque to the shaft when the energized brake coil pulls the armature against the motionless housing. The range of sizes for the miniature and small units of all styles is from ⅞ to 3⅛ inches OD. Units can be supplied to transform 110v current to 6, 12 or 24v. **Simplatrol Products Corp.**, Worcester, Mass.

Circle 438 on Inquiry Card

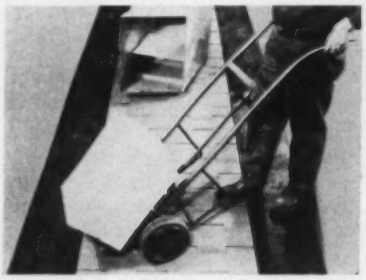


Teflon Hose

Developed for applications where unusual exposure to wide temperature ranges and injurious chemical action is encountered, industrial Teflon hose has detachable reusable fittings. The hose is expected to be used in the atomic energy and chemical industries. Other applications include steam lines, hot asphalt lines, and installations with fluid temperatures in the −100 to 500F zone.

Features of the reusable fittings include a beveled shank which eliminates the possibility of loose inner tube particles entering the fluid system; ability to hold proof and burst pressure, even after aging; permanent blow-off protection; and positive line seal. **Aeroquip Corp.**, Jackson, Mich.

Circle 439 on Inquiry Card



Flat-Top Belt

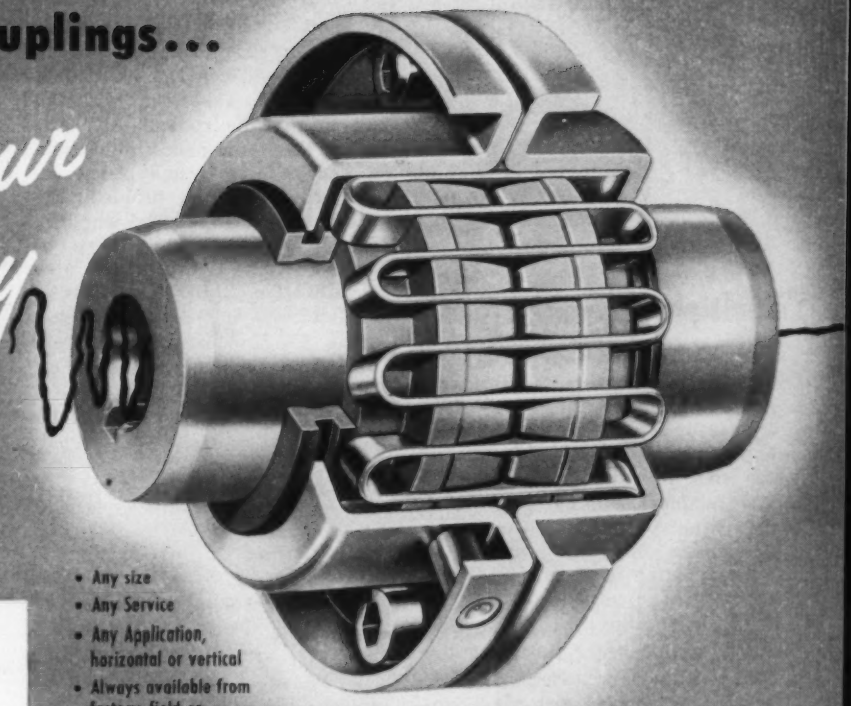
This conveyor is suitable for general applications in metalworking, including assembly and part forming, and also for assembly of large products such as refrigerators, stoves, automobiles, machine tools, farm machinery, washing machines and large castings. In addition to providing all the advantages of the ordinary slat type conveyor belt with its carrying surface located above the side chains, this flat-top conveyor eliminates the operating hazards inherent in the former type of belt resulting from the opening and closing of the slats on convex and concave turns.

The belting is well suited for use in flush-with-the-floor applications for heavy-duty assembly work. Belt clearances are such that ordinary bolts, nuts, small wrenches and miscellaneous small tools common to assembly line work will not fall through the belt. Belt length, width, speed and carrying capacity can be varied to meet the needs of individual applications. **May-Fran Engineering Inc.**, 1761 Clarkstone Rd., Cleveland 12, O.

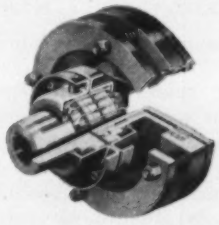
Circle 440 on Inquiry Card

Falk Steelflex Couplings...

Protect your machinery in 2 ways



- Any size
- Any Service
- Any Application, horizontal or vertical
- Always available from factory, field or distributor stocks

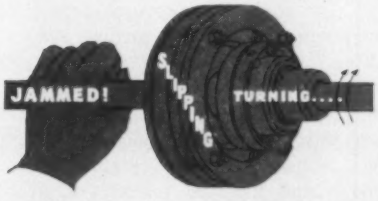


Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance . . . are easy to install, lubricate and disconnect . . . and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

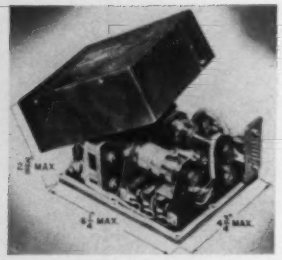
FALK

...a good name in industry

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

Circle 603 on Inquiry Card



Multiple Sequence Timer

Developed for military and commercial automation applications, six-in-one, rapid response, long life multiple contact sequence timer handles up to six separate timing sequence operations simultaneously. Switches can be actuated by a magnetic clutch and cam arrangement which resets to zero upon completion of the timing cycle, or in event of power failure to the unit. In addition to the clutch actuated switches, the timer contains five continuously pulsating switches, one of which continuously operates in a closed position for 0.050 $\pm$0.010 seconds and open for 0.450 $\pm$0.040 seconds.

Switches operate under 0.250 amp load at 115v, 400 cycle over an input voltage range from 24 to 30v dc. Timing cycles can be tailored to fit the desired application. Specially designed switching devices are capable of up to 5 million actuations. **Avionic Div., John Oster Mfg. Co.,** Racine, Wis.

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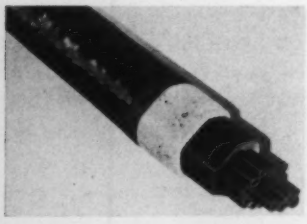

Instrument Line Harness

Designed for use in chemical processing and petrochemical plants, refineries, etc., fire and impact resistant instrument line harness is known as Dekoron Super Poly-Cor. The unit is the multiple tube construction type and is light and supple. It can be used in hazardous areas where flash fires or welding splatter are a danger, or can be buried in the ground.

The harness is composed of a bundle of ¼-inch OD linear polyethylene core tubes that withstand all normal instrument line pressures. Over this bundle is extruded a heavy thermal and shock barrier covered with braided, fireproof AA asbestos. The whole assembly is covered with an extruded flame retardant outer sheath. The Super Poly-Cor is available in increments of 100 ft or in 500-ft coils. **Dekoron Products Div., Samuel Moore & Co.,** Mantua, O.

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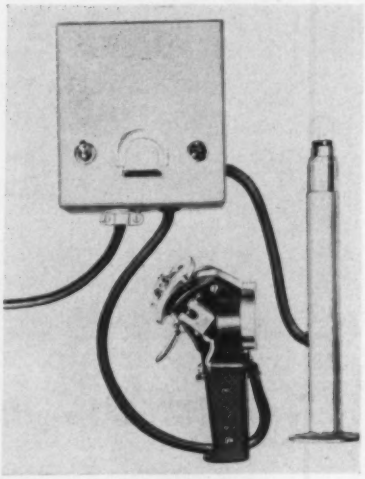

Tension Indicator

A feature of tension meter is an electrical contacting device which calls the attendant by the flashing of an electric light when tension goes above or below preset limits of best operation in textile, wire and rubber mills. In the illustration, the tension annunciator is attached to the Saxl tension meter.

Mounted upon an insulating cover, a U-shaped holder on top of the meter holds two tension setting screws with special contact points. They can be adjusted so that the lever tilting between them makes contact at any desired tension. Connected to the sensing lever in between them travels an electric contact, the position of which is determined by the tension. Filaments are guided over the rollers of the electric tension indicator. A warning light flashes if tension falls below or exceeds the limits of best running conditions. The contacts are free from arcing due to a special circuit. **Tensitron Inc.,** Harvard, Mass.

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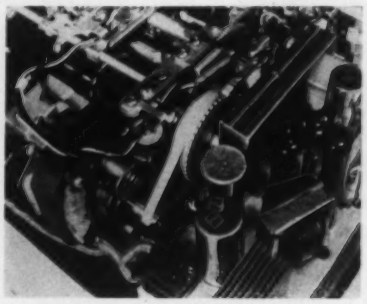


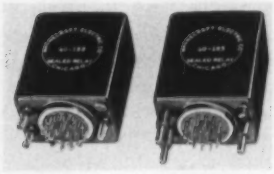
Seamless Rubber Belt

Developed to solve a variety of drive and feed belt problems, seamless rubber belt will not stretch. A feature of the endless belt is the straight-line cord interliner, vulcanized between two layers of synthetic rubber, that keeps the belt from stretching. Because of this nonstretch quality, an unchanging length is maintained, thus eliminating the possibility of slippage in applications where a positive drive must be maintained constantly. In addition, the device can be used as a drive belt on dictating machines, tape recorders, and industrial pumps and compressors, or as a feed belt on packaging machines, duplicating machines and postage meters.

In one installation, a dictating machine manufacturer is using a ⅜-inch wide belt in a power transmission application. A package machinery builder is using a much wider belt for conveyor work. Various size belts are run on postage meter, automatic duplication and tape recording equipment. In the illustrated application, the belt is ¼-inch wide and is used as a drive belt for connecting several driven members in a voice recording machine.

Belts can be made in many lengths, widths and thicknesses, and produced in most types of rubber, including nitrile, styrene, neoprene and natural rubber, or in combinations. The cord interliner may be any size from fine yarn to tire cord. **Armstrong Cork Co.,** Lancaster, Pa.

Circle 444 on Inquiry Card



Miniature Relay

Developed for the reliable switching of a variety of circuits, Class 11-6PDT hermetically sealed relay is available with various contact arrangements and contact ratings up to 5 amp. The relay can be furnished with specially designed dry circuit contacts. For dc operation, it is available in a wide range of coil operating voltages or currents.

The device is furnished hermetically sealed with 20-pin octal plug or 20-pin solder terminal header. It is also available open or with dust-tight enclosure. **Magnecraft Electric Co.**, 3354D W. Grand Ave., Chicago 51, Ill.

Circle 445 on Inquiry Card

Scaler-Counter

Designed for applications including frequency division, random counting, preset counting, accumulators and television sweep synchronizing, plug-in scaler-counter uses a pair of magnetic cores as count determining elements. The one-tube unit operates from dc to 50 kc, with scales of nine, ten, and 11 available.

Overall size of the scaler-counter, called the Magnivider, is 1¼ by 3½ by 5½ inches. Only 150v at 15 ma and 6.3v at 0.3 amp are required for operation. Two outputs provide 40v at high impedance and 4v at low impedance. With extended circuitry, visual readout can be obtained. **Magnetics Research Co.**, 255 Grove St., White Plains, N.Y.

Circle 446 on Inquiry Card

INSTANT CONTROL FROM ANY ANGLE!

On operations where instant control is imperative install a mushroom-head pushbutton. Even a gloved hand can find it easily from any angle in every emergency. One fast push and you are in command.

Westinghouse mushroom heads are available in a wide range of colors and materials... the popular red plus seven other shades of homogeneous, longer wearing plastic. For more rugged applications there are the anodized aluminum buttons in plain, black and bright red.

In Westinghouse Oil-Tite* controls, both operators and enclosures are moistureproof. A tight rawhide seal around the stainless steel operating shaft prevents oil and other harmful liquids from reaching electrical connections. And drainage holes will not allow liquids to be trapped in the housing. Enclosure covers are tightly gasketed with mounting holes in separate wells. Oil simply cannot seep in.

These pushbuttons are tailored to your needs... at standard prices. All parts are interchangeable permitting minimum stocking of components.

Booklet B-7022 will tell you more about Oil-Tite controls, and the new 72-page pushbutton guide B-6749 will give you information on the complete line. Write to Westinghouse, Box 868, Pittsburgh 30, Pa. *Trade-Mark

J-30251

YOU CAN BE SURE... IF IT'S Westinghouse

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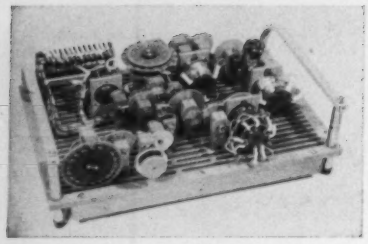

Servosystem Components

Designed especially for airborne 400-cycle servosystems, line of miniature servomechanical parts is well suited for applications where space is at a premium and low system inertias are required. The line is equally adaptable to prototype or production servo applications.

Parts in the line include miniature slotted mounting plates, hangers, dial assemblies, mechanical and electrical stop assemblies, couplings, differentials, and a complete line of precision Class II gears. Parts are designed for use with ⅛-inch shafting. Gears are supplied in 64, 96, and 120 diametral pitches. **Reeves Instrument Corp.**, 207 E. 91st St., New York 28, N.Y.

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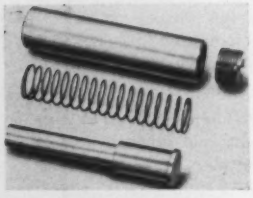
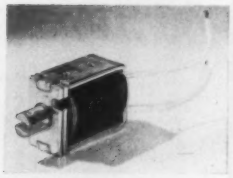


Single-Acting Cylinder

Used both as a kicker in press-room installations and as a disappearing back gage pin facilitating loading and unloading of stampings, single-acting cylinder has only two moving parts. The unit can be adapted to a variety of applications including lifting, ejecting, clamping, back gaging, etc.

The cylinder measures 3½ inches plus stroke in length, and 1¼ inches in diameter, and can be actuated by a 30 psi air line. Strokes most frequently used are the 2½, 4½ and 6-inch types. The device is made with a thin walled piston rod, eliminating damage to die sections in the event of air line failure. Total collapsed thickness of the piston rod is comparable to the gage of metal being formed or fabricated in the dies. **Sahlin Engineering Co. Inc.**, P.O. Box 289, Birmingham, Mich.

Circle 448 on Inquiry Card



DC Solenoids

For automatic process control, automatic machinery and communications, 100 and 300 series dc miniature solenoids feature lightweight, maximum power-to-size ratio, and plungers designed for push or pull, plus a wide variety of mountings, coils and wire sizes. Typical of the series of dc solenoids is the model SO-151 (illustrated) which has a coil rated at 1500 ohms wound on molded nylon bobbin. Dielectric strength is 1200v, coil to frame; stroke is from 1/32 up to ¼-inch. Pull with 3/16-inch stroke is 9 oz at 110v dc. With variations of wire size, the Model SO-151 coil resistance may be varied between 0.004 up to 8200 ohms. Coils can withstand 8w continuously and as high as 70w intermittently with standard insulation. High-temperature insulation is available for as high as 25w continuous duty. **Joseph Pollak Corp.**, 81 Freeport St., Boston 22, Mass.

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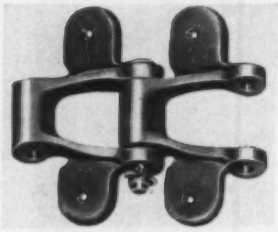

Conveyor Chain

Pin type steel conveyor chain has each link made with a wing attachment and is designed to stand hard wear and shock. It can be furnished for acid or heat conditions using corrosion- or heat-resistant materials. The chain is easy to take apart or assemble because of its simple design. Wing attachment on each link makes it easy to attach wood or metal conveyor slats for all types of duty. The device can be used in single or multiple strands. The links need not be matched; the chain is available in standard pitches. Sprockets and complete conveyor aprons can be supplied. **Robert A. Main & Sons Inc.**, 257 Pascack Rd., Paramus, N.J.

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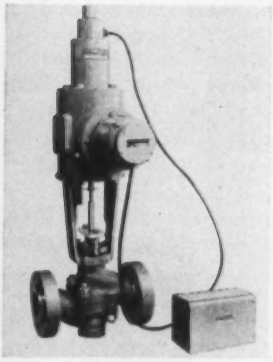
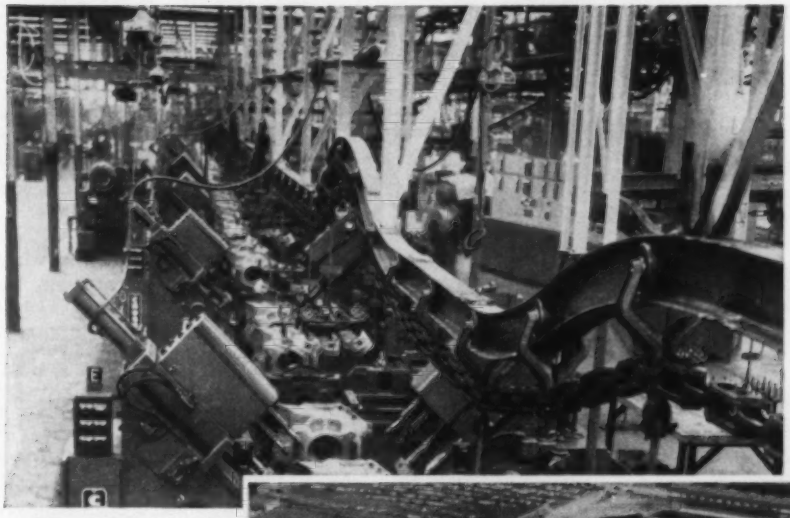


Positioning Device

Series D actuator, an all electric proportional positioning device, is designed for use in conjunction with modern electronic control systems. The actuator requires no intermediate pneumatic or hydraulic operating fluids. The device is suitable for application on valves and other processing equipment such as single-seated and double-ported control valves, butterfly valves, proportioning pumps, mechanical and electrical speed controllers, etc. The actuator is also applicable in automatic control involving transmission of signals over long distances, such as encountered in tank farms and pipe line services; and use in toxic atmospheres, or in areas where extremely low ambient temperatures are present.

The actuator has a stroke length of ¼ to 2 inches with a stem speed of 4 ipm at the maximum rated output of 500 lb of thrust. The complete assembly of motor and

In the Spectacular PLYMOUTH ENGINE PLANT you see



VICKERS®
HYDRAULICS
Wherever You Look

Plymouth Engine Plant is 980' long and 500' wide. Indicative of its scope is crankshaft machining requiring 4500 linear feet of automation composed of 385 individual units. Plant capacity is 150 engines per hour.

(Above) View of Plymouth Engine assembly line

In the new Plymouth "Qualimatic" Engine plant you see Vickers Hydraulics on every side. Hundreds of machines in this latest and greatest example of automation are Vickers equipped.

Both builders and users of production equipment appreciate the significant advantages of Vickers Hydraulics . . . advantages that help produce better products at lower cost.

A specific need in the Engine Plant is standardization on a few basic hydraulic units to keep down parts inventories. The Vickers line makes standardization easy. Also desirable are hydraulics in units quickly demountable . . . so that by replacing units, repairs on the job are avoided and costly downtime reduced. Vickers has extensively developed demountable unit construction.

Whether automated or not, more and more plants have more and more Vickers Hydraulics. For further information, write for Catalog 5002B.

VICKERS HYDRAULICS is used on machines supplied by these Companies to Plymouth Engine Plant

American Broach & Machine Co.
Barnes Drill Company
Bilt-Rite Tool & Machine Co.
Buhr Machine Tool Company
Colonial Broach & Machine Co.
Crankshaft Machine Company
The Cross Company
Ex-Cell-O Corporation
Fitchburg Engineering Corp.
Greenlee Bros. & Company
Industrial Metal Products
The LaPointe Machine Tool Co.
Landis Tool Company
The R. K. LeBlond Machine Tool Co.
Lees-Bradner Company
Michigan Drill Head Co.
Micromatic Hone Corporation
Micro-Poise Engineering & Sales Co.
Modern Industrial Engineering Co.
The Motch & Merryweather Machinery Co.
Norton Company
A. P. Schraner Co.
The Sheffield Corporation
Snyder Tool & Engineering Co.
Sundstrand Machine Tool Co.
Jervis B. Webb Co.
The Wickes Corp.
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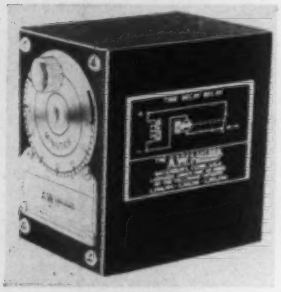
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

7545

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

yoke is only 25 inches high and weighs less than 35 lb; it can be mounted in any position and is not effected by normal vibration. **Conoflow Corp.**, 2100 Arch St., Philadelphia 3, Pa.

Circle 451 on Inquiry Card



Time Delay Relays

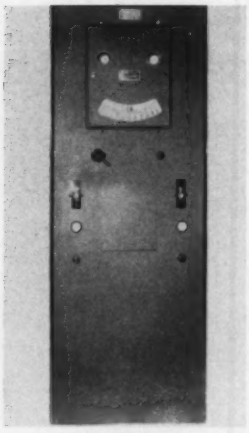
Useful where frequent change in time setting is necessary, line of dial adjustable time delay relays includes surface and flush mounting types. Clutch holding contacts can be supplied as a special feature on any of the models. Reverse clutch action can be incorporated so that the clutch is normally locked in. The unit then will be in the timed out position normally, and will reset to the starting point when the clutch is momentarily energized. With the clutch coil wired through an external switch, the unit will time out and maintain position without power consumption. Timing accuracy is determined largely by accuracy of the timing motor, which in turn is dependent upon line frequency or line voltage. When close tolerances are called for, chronometrically governed dc motors maintain accurate speed over a wide voltage range.

Both the surface mounting type (illustrated) and the flush mounting types are available with as many as four switches for special applications. **A. W. Haydon Co.**, Waterbury, Conn.

Circle 452 on Inquiry Card

Indicator and Controller

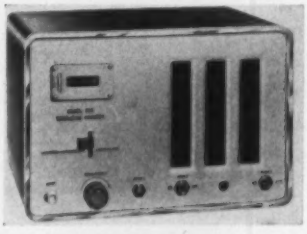
Sensitive, automatic gage which measures, records, if desired, and maintains the level of fluid in tanks, bins, kettles or furnaces is called the Auto-Level. Well suited



for applications where physical contact with the material being measured is undesirable, the Auto-Level utilizes changes in differential air pressure to indicate and control the level of the fluid.

In operation, a tube through which a constant air supply flows, is lowered near the surface of the fluid being measured. As the level of the fluid rises, it creates a restriction to the flow of air and causes a back pressure to occur within the sensing tube. Conversely, as the distance between the sensing tube increases there is a lowering of the back pressure. The variation of the back pressure in the sensing tube is magnified by a differential pressure controller with an amplifying stage. A second tube, installed well above the fluid level, is used to compensate for any change in the ambient pressure. The back pressure is used to control the level of the fluid with a simple *On-Off* system. Proportional or time delay control is also available. **General Glass Equipment Co.**, Five S. Virginia Ave., Atlantic City, N. J.

Circle 453 on Inquiry Card

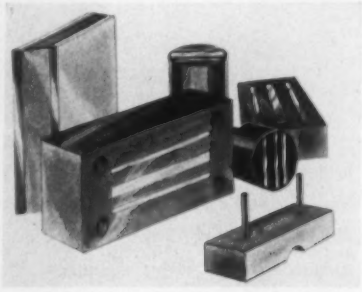


Totalizing Counters

Designed for industrial and special purpose counting, direct reading totalizing device handles any electrical, mechanical or optical event which can be converted into electrical impulses. Transducers to effect impulse conversion can be photocells, magnetic coils or switches. Typical applications include: Automatic totalizing of production units of practically any size or shape (cans, bottles, bottle caps, penpoints, nuts, bolts, etc.); measuring the characteristics of engines, turbines and electric motors; counting the total revolutions of high speed shafts and related measurements; and any other operation where a total count is desired.

Features of the totalizing counter include accuracy, high speed, two outputs (relay and pulse) and reliability. Models are available from one to four decades; count capacity is from 999,999 to 999,999,999. Counts per second range from 0 to 150 to 0 to 100,000. **Computer-Measurements Corp.**, 5528 Vineland Ave., N. Hollywood, Calif.

Circle 454 on Inquiry Card



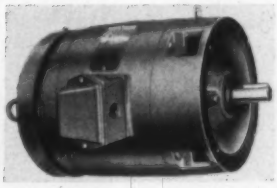
Magnetic Assemblies

Used in the transfer of parts or retaining of parts in assembly operations, permanent magnetic assemblies are designed for the metalworking field. Specific applications of the assemblies include spot welders, plating racks, holding fixtures, gaging, dies, and assembly fixtures.

The magnets have maximum resistance to demagnetizing fields and will recover even when demagnetized to zero flux. The assemblies are available in standard sizes from $\frac{3}{8}$-inch diameter and up. The units are insulated for insertion in steel holders. The ceramic Indox magnets are attached to soft steel pole pieces and then molded into an epoxy resin;

only the contact surface of the pole pieces are exposed through the resin. **Storch Products Co. Inc.**, 9232 Greenfield, Detroit 28, Mich.

Circle 455 on Inquiry Card



Vertical Motors

Adaptable for all vertical pump installations, line of totally protected, vertical solid shaft P-base motors has normal thrust bearings in all sizes from 1 to 40 hp. Motors are available in protected, totally enclosed or explosion proof enclosures.

Designed for indoor and outdoor installations, all of the motors are corrosion proof for long, safe operation under adverse conditions, as are frequently found in the process industries. The shaft is sealed by a neoprene slinger that protects bearings and windings from foreign matter. The mounting flange face and rabbet fits are machined after assembly to assure perfect mating with the pump flange and to provide positive shaft alignment for quiet, long-life operation. Metermatic lubrication automatically regulates the correct flow of lubricant to the bearings. Automatic grease relief prevents bearing damage from grease pressure or over-lubrication. **Reliance Electric & Engineering Co.**, 1088 Ivanhoe Rd., Cleveland 10, O.

Circle 456 on Inquiry Card

Conveyor Corner

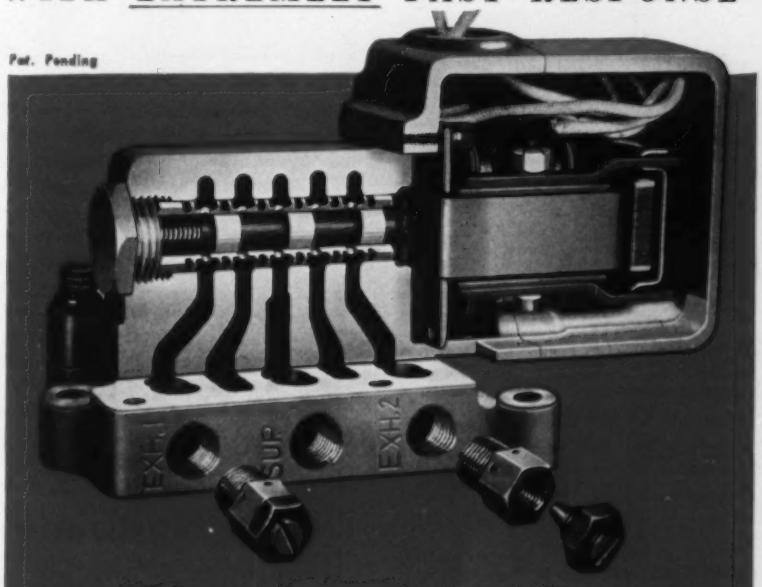
Designed to adapt a conveyor to almost any floor space or processing equipment, corner is adjustable to 180-degree turns on as small as a 5-inch radius and for horizontal turns and vertical turns to 128 degrees. Adjustments of corners can be made on the job, permitting flexibility to meet special requirements.

The corners are used in conjunction with continuous Conveyor-A-Series. This conveyor con-

now ... AIR VALVES

WITH EXTREMELY FAST RESPONSE

Pat. Pending



...Almost TWICE As Fast As Ordinary Valves!

The new SA Series single solenoid actuated valves are available in both single and dual pressure models with extremely fast response time. You get total response in 12 *milliseconds*—from energizing to wide open on 60 cycle current. That's almost *twice as fast* as any pilot operated solenoid control valve available today!

All SA Series valves are high performance, full pipe area valves . . . furnished for service on vacuum and air at pressures from atmospheric to 250 psi . . . and at speeds from the most intermittent job in your plant to welding guns. Optional metering valves give simple, sensitive control of piston speed by metering the exhaust air. Exhaust noise is muffled.

The design simplicity of the SA Series valves provides extremely long life and requires a real minimum of maintenance. Only one moving part provides the valving action . . . a corrosion-resistant steel spool and sleeve.

Complete information on the SA Series valves . . . the greatest advance in air controls . . . can be obtained by writing today for your copy of Catalog 8000.

NUMATICS, Inc.

MILFORD, MICHIGAN • DEPT. A

Circle 606 on Inquiry Card

Precision Torque Wrench Triples Nut Running Speed within 1% Torque Accuracy

Precision Torque from 6 to 300 inch-lbs.

Transmits torque through medium of patented Magnefluid drive with no mechanical connection between discs for smooth, reliable and accurate torque. Runs and torques nuts and screws in one simple operation. Instantly variable from 6 to 300 inch-pounds with repetition torque accuracy guaranteed within 1%. Actual production line time studies reveal time savings in nut running and screw driving up to 75%.

Rugged construction to insure long, dependable life. No wearing parts in torque transmitting elements.

SPECIFICATIONS TW-300

	Drive 1	Drive 2	Drive 3
Maximum Torque	300" lbs.	60" lbs.	250" lbs.
Minimum Torque	40" lbs.	6" lbs.	25" lbs.
Side to Center	1¼"	1¼"	1¼"
Total Weight	6¼ lbs.	5¼ lbs.	5¾ lbs.
Socket Drive Size	⅜"	110-60 a. c.	¼ amp.

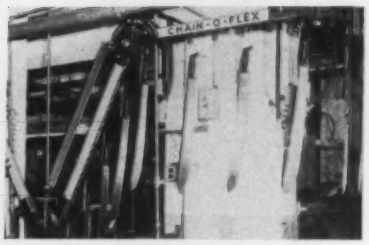
$155 plus air motor,
F.O.B. Sioux Falls, S. D.

Write for literature or order on 10-day approval

SWIFT TOOLS, INC. Dept. A. Sioux Falls, S. D.

Also mfgs. of dynameters, torque recorders, and magnafluid clutches for special torque control problems.

Circle 607 on Inquiry Card

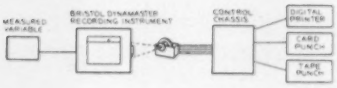


sists of link chain moving in steel tubes. Standardization of drives offers three sizes. Drive units are available with single-speed or 3 to 1 infinite variable speed adjustment. Systems up to approximately 350 ft and loads up to 30 lb per ft are practical with one drive. Conveyor hooks may be spaced as close as 6-inch centers. Top and bottom vertical turns, horizontal turns, track clamps and chains are available. **Chain-O-Flex Corp.**, 3334 Lincoln Ave., Franklin Park, Ill.

Circle 457 on Inquiry Card

Recording Potentiometers

Developed for use with analog-to-digital conversion devices, high speed self-balancing recording potentiometers are designed to give full scale traverse in 0.4-second. The electronic Dynamaster can be equipped with most of the standard digital readout devices available. Ample torque is available for operating retransmitting slide wires, alarm contacts, and other auxiliary devices without affecting the dynamic characteristics.



Round chart models are also available for applications where prominent indication of the variables is needed while feeding digitized information to data handling equipment. Various pen speeds can be supplied, depending on the speed requirements and type of converter used.

Accuracy and reliability of the potentiometer and bridge instruments are unchanged when being used with the converters. Any measurement which can be converted to an electrical value can be read out in this way including temperature, pressure, flow, differential pressure, pH, speed, power, smoke density, etc. **Bristol Co.**, Waterbury 20, Conn.

Circle 458 on Inquiry Card

For AUTOMATION

• TELEMETERING
• REMOTE CONTROL

This Tech Lab stepping switch is built around the well known Type 2A tap switch—still unmatched for quality and long life. The Type 20A will handle more voltage and current than other stepping switches. Ideal for rotary relays because there's never any chattering due to vibration. A perfect component for Automation, Telemetering and Remote Control Equipment.

Type 20A Specifications:

- Standard types furnished with 1-7 decks and 1-4 poles per deck
- Switches may have up to 24 contacts
- Contact Resistance: 3-4 milliohms
- Contact Material: Silver plated brass or silver alloy
- Current carrying cap.: 3 amp.
- Size: 1¾" dia.

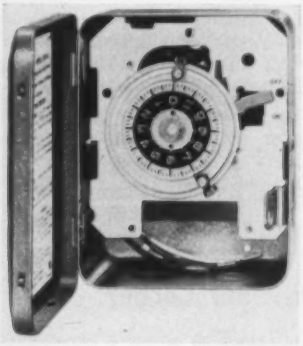
Type 20A
Solenoid Operated
STEPPING SWITCH

TECH LABORATORIES, INC.

Manufacturers of
Precision Electrical Resistance Instruments
PALISADES PARK, NEW JERSEY

VISIT US AT BOOTH 3034—IRE SHOW

Circle 608 on Inquiry Card



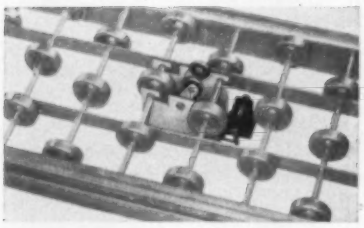
Cycle Timer

Developed for controlling *On-Off* cycles from 10 seconds to 12 minutes, timer is known as the Intermatic Cycler-12. It is recommended for use on ventilating fans, pumps, process timings, and other industrial uses requiring flexible cycles of operation. The timer provides a variety of repetitive

timings. *On* operations may range from 10 seconds to 11 minutes, 10 seconds. *Off* operations may be as short as 50 seconds to 11 minutes, 50 seconds. The time dial accommodates up to 12 sets of *On-Off* trippers.

The timer is presently available for 125v operation with a capacity of 1875w. Other features include manual control without interrupting the automatic cycle and a snap-out mechanism. **International Register Co.**, 2624 W. Washington Blvd., Chicago 12, Ill.

Circle 459 on Inquiry Card



Case Counter

An accurate traffic count on wheel conveyor lines is afforded by automatic case counter. The unit carries totals to 99,999. Easy installation of the counter without tools or alteration of wheel pattern makes it possible to have an accurate count of several lines by switching from line to line as necessary. The counter can be positioned for flow counting in either direction and hooks quickly over the axles of a conveyor line when flow direction is changed. **Rapids-Standard Co. Inc.**, 342 Rapistan Bldg., Grand Rapids 2, Mich.

Circle 460 on Inquiry Card

Control Gear Motor

Designed to provide remote and automatic control for variable speed drives, valves, pumps, feeders and other machines, shaft mounted gear motor is called the Jordan Shaftrol. The unit mounts easily on shafts from ¼ to ⅞-inch in diameter. It is furnished with a torque arm or torque plate with resilient mounting that absorbs any runout that may be present in the shaft to be controlled. When used on rising stem

valves, the torque plate is equipped with linear bushings to allow axial movement.

The gear motor can be installed in place of standard handwheels, knobs or cranks and thereby provide remote or automatic control as an optional feature without change in the design of the machine. Speeds from ½ to several hundred rpm are available in the units. Shaftrols are available to provide torques from a few inch-oz to several hundred inch-lb. Single-phase units use an instantly reversible permanent split capacitor motor having high starting torque with low inrush current. Three-phase gear motors are available in the larger sizes. **Jordan Co. Inc.**, 3235 W. Hampton Ave., Milwaukee 9, Wis.

Circle 461 on Inquiry Card

ENGINEERING TIME IS PRECIOUS...why waste it?

GET AUTOMATION AT LOWEST COST WITH SWANSON STANDARD INDEXING MACHINE CHASSIS

No longer is it necessary to build your special purpose and automatic machines "from the ground up". More and more progressive manufacturers are finding that Swanson Standard Indexing Chassis save engineering man hours and costs—get the job done in less time and for less money

These versatile "packaged" units provide the basic chassis for a wide range of special automatic machines. They are illustrated and briefly described in Bulletin 356K. *Write for your copy.*

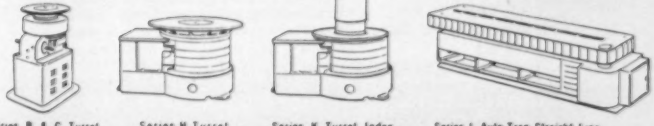
SEC

SWANSON-ERIE CORPORATION

814 EAST EIGHTH ST., ERIE, PA.

ENGINEERS AND BUILDERS OF AUTOMATIC AND SPECIAL PURPOSE MACHINES SINCE 1919

OVER 200 STANDARD MODELS



Series B & C Turret Index Models—for medium and light applications.

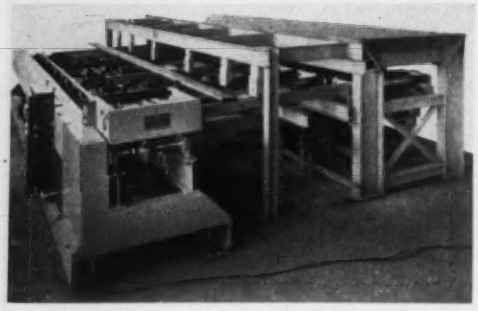
Series H Turret Index Models—for heavy duty applications.

Series K Turret Index Models—for heavy duty applications with center column tool mounting.

Series L Auto-Tran Straight Line Indexing Chassies—for automatic or semi-automatic assembly and processing operations.

Circle 609 on Inquiry Card

SPURGEON Automatic Bar Feeder



for handling long round bars or tubes from hopper to shear

10,000 lb bundles are dropped into hopper, shown at right. Metering transfer table, in center, transfers the bars to the "V" roll conveyor, shown at left, through metering hands and escapement fingers, which release one bar at a time upon receipt of a signal from the "V" roll conveyor, thus the powered "V" roll conveyor feeds the shears automatically and continuously at its maximum capacity.

SPURGEON CO. Since 1923 — DO IT AUTOMATICALLY — SPURGEON AUTOMATION — DETROIT, MICH.

SPURGEON COMPANY SINCE 1923

23505 HOOVER RD.
VAN DYKE, MICHIGAN

Circle 610 on Inquiry Card

FROM THEN...
...TO ETERNITY
1924
The U. S. Drill Head Company's first Fixed Center Drill Head was produced for Borg and Beck, of Chicago — a subsidiary of Borg-Warner.
1957
The 50,000th Head was shipped.

For men who know drill heads best, it's always U. S. Drill Head ...5 to 1

Since 1915, when the U. S. Drill Head Co. built its first adjustable head, it has far surpassed all other similar manufacturers because of its engineering and production facilities.

Manufacturers of all types of adjustable, fixed center and individual lead screw tapping heads.

US DRILL HEAD — THE UNITED STATES DRILL HEAD COMPANY
BURNS STREET • CINCINNATI 4, OHIO

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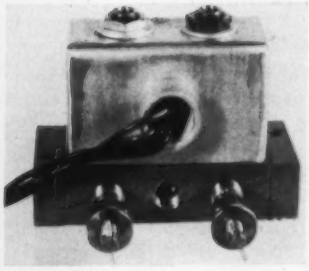


Control Valve

Addition to line of ¼-inch air or hydraulic control valves is the single or double-solenoid operating model. Valve is designed for use in oil hydraulic or air circuits operating at 50 to 120 psi. It is available with exhaust speed control valves as shown, or open ¼-inch NPT female ports.

Measuring overall only 4 9/16-inches long, 3 5/16-inches high and 1¾-inches wide, solenoid valve is available in both three-way (three port) and four-way (five port) types for many ac or dc voltages. All seals are standard O-rings, replaceable without disturbing piping. **Modernair Corp.**, 400 Preda St., San Leandro, Calif.

Circle 462 on Inquiry Card

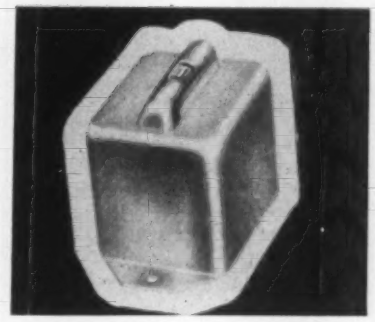
Plug-In Circuitry Kit

Designed to allow the engineer to mount, house and package his electronic circuitry so that it is easier to install, operate and maintain, an assortment of components for plug-in unit construction is included in Laboratory Kit #37. The components simplify the engineer's problems of circuitry layout, construction and trouble shooting.

Using the components to organize circuitry provides final equipment that has (1) Circuitry subdivided by function as individual plug-in units that slide in, lock or eject with half-turns of handles on

chassis front panels; (2) plug-in chassis functions that mount in mobile or portable racks so the equipment or system is easy to install; (3) tiny front panel indicators and accessible points of check for in-out wiring on each plug-in unit; and (4) individual plug-in chassis with carrying cases for easy air shipment to a service center. **Alden Products Co.**, Dept. #KT7, Brockton, Mass.

Circle 463 on Inquiry Card



Switch Indicator

The open or closed condition of a switch is indicated by Doylite Switcheck, proving the correct mechanical position as well as the electrical condition of the switch. It is applicable in connection with the operation of machines controlled by precision snap action switches, or in manufacturing plants seeking efficient and profitable automation. The device minimizes the costs of down time and shortens or prevents intervals of production stoppage by signaling "trouble ahead" or by immediately pinpointing the failure of an electrical circuit.

The Switcheck contains a small neon lamp which is supplied by an isolation transformer through a current limiting resistor with sufficient voltage to cause ionization. The switch under observation is connected across the neon lamp through a resistor. If the switch is open the neon lamp is illuminated. When the switch is closed, the resulting voltage drop causes de-ionization of the neon lamp. The dc resistance in parallel with the switch is approximately 150,000 ohms. **Doyle Design & Machine Co.**, 51-57 Scio St., Rochester 4, N.Y.

Circle 464 on Inquiry Card

Standard 12 stop Intermittor with specially jig-bored 36" dial.

PRECISION INDEX TABLES FOR HIGH SPEED PRODUCTION

CAN YOUR PRESENT MACHINERY PRODUCE 30,000 PIECES AN HOUR?

Few production machines can . . . but it's possible with the Ferguson Intermittor Index Table. There are models capable of 30,000 indexes an hour if your machinery and tooling can keep up with them. The point is *. . . the Intermittor does not limit the speed of your machinery the way geneva driven or air or hydraulic operated tables do.*

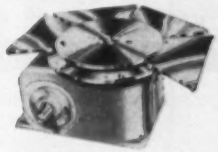
Perhaps speed is not your problem, but excessive maintenance costs are . . . resulting from the clanging, banging and jarring you get from a geneva drive. Here again you find the solution in an Intermittor. Employing modified trapizoid acceleration characteristics, the Intermittor has an initial acceleration point of zero with a gradual increase to the maximum and an equally gradual decrease to zero again . . . *all of which means that the Intermittor is a smooth operating table with minimum shock and vibration.*

Or maybe you like accuracy . . . but don't like shot pins. The Intermittor Indexing mechanism has an accuracy of .001" with zero backlash — *and no shot pins!*

There are many more reasons why you should install an Intermittor when you need a rotary table for large volume production, including the fact that you can select one of 150 standard models from a catalog and get exactly what you need in terms of dial size, number of stations and indexing period.

OVER 150 STANDARD MODELS TO CHOOSE FROM:

Standard 24 station Intermittor with 30" dial and optional stationary tooling plate above the dial.



6 station Intermittor with 12" dial and special tool mounting brackets.

Standard 18 station Intermittor with 48" dial.

Send for our Catalog No. 301 . . . it has a definite place in your file if you have the responsibility of speeding up production or converting to automation.

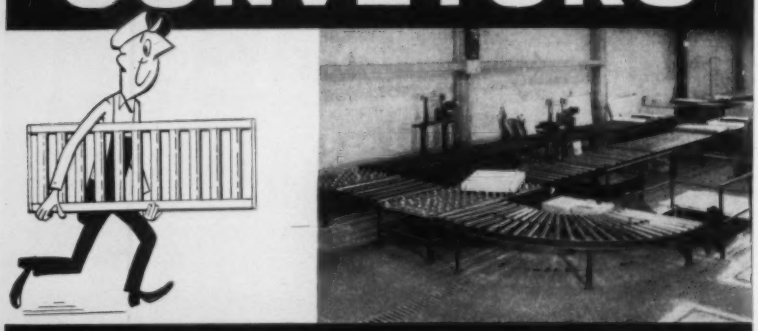
HIGH SPEED INDEXING • STANDARD TRANSFER MACHINES • AUTOMATIC TOOLING

FERGUSON MACHINE CORPORATION OF INDIANA

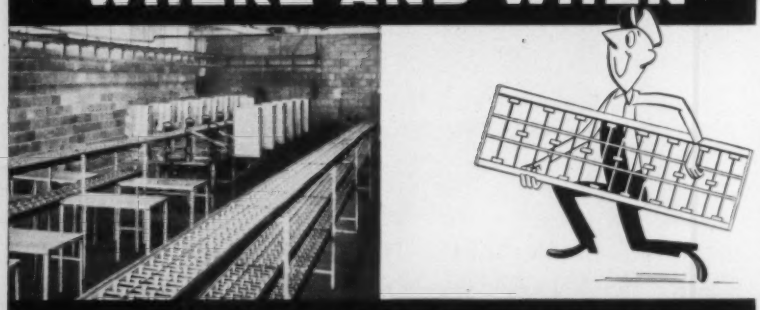
Roller Gear Division, Dept. AI-3 • P.O. Box 5841, St. Louis 21, Mo.

Circle 612 on Inquiry Card

CONVEYORS



WHERE AND WHEN



YOU NEED THEM

BY BUSCHMAN

Exclusive design features make Buschman portable conveyors . . . wheel, roller and powered belt . . . quickest and easiest to move and put into operation. Durably constructed to withstand the roughest usage, these versatile conveyors have an unlimited range of application in production, warehousing, packing, shipping and receiving operations.

Pre-engineered standard components are combined into a conveyor system custom-tailored to your particular job. Then, whenever requirements change . . . wherever a new need arises . . . your system can be rearranged or relocated in minimum time . . at minimum expense.

Buschman portable conveyors are stocked at the factory and by leading distributors across the country. We'll gladly assist in surveying your plant to develop ideas which will cut costs, boost profits.

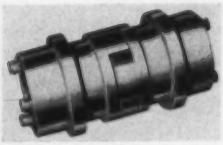
Write today for catalog and name of nearest representative.

PRODUCE MORE ... FOR LESS
Buschman Conveyors
C-221-EWB

THE E. W. BUSCHMAN COMPANY
4551 Clifton Avenue, Cincinnati 32, Ohio

CONVEYOR SYSTEMS FOR ALL INDUSTRIES
ENGINEERED • MANUFACTURED • INSTALLED

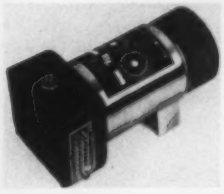
Circle 613 on Inquiry Card



Flexible Coupling

Well suited for applications where driven equipment such as a pump must be disconnected while the driving unit continues to operate, radially removable flexible coupling provides a simple means of disconnecting two units without axial movement of the shafts. Known as the Type RRL, the coupling is lubrication free. There is no wear on the metal jaws since the load is transmitted by compression of the one-piece load cushion. Horsepower ratings range from 7.5 to 40 at 1800 rpm. Maximum bores range from 1⅜ to 2¼ inches with maximum OD from 2 9/16 to 5 inches. Maximum overall length is from 6⅛ to 7⅝ inches. **Lovejoy Flexible Coupling Co.**, 4984 W. Lake St., Chicago 44, Ill.

Circle 465 on Inquiry Card



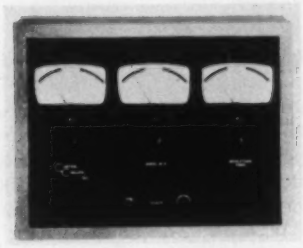
Telemetering Commutator

Long service life and high accuracy are features of two-pole telemetering commutator. The unit is contained in a hermetically sealed case. Powered by a 400-cycle, 115v, two-phase motor, the commutator requires only 7w to provide 10 rps pole speeds, and only 15w for 30 rps pole speeds. The brushes or poles are special metallic alloys dynamically balanced and mounted on jewel pivoted bearings with low spring rates.

The commutating surfaces are comprised of internally segmented cylindrical sections. Prior to assembly, these sections are slotted with the accuracy of an index head on a milling machine, so that interpole phasing accuracies of 0.2 milliseconds can be maintained at 30

rps pole speeds. Contact resistances of less than 0.25 ohms are practically invariant during the entire use of the commutator. Intercontact impedances exceed 100 megohms for the life of the instrument. **Instrument Development Laboratories Inc.**, 67 Mechanic St., Attleboro, Mass.

Circle 466 on Inquiry Card



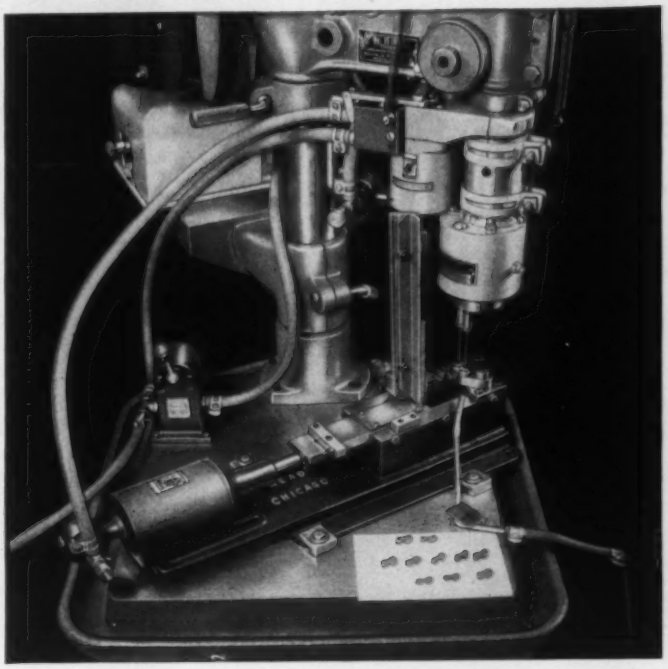
Indicating System

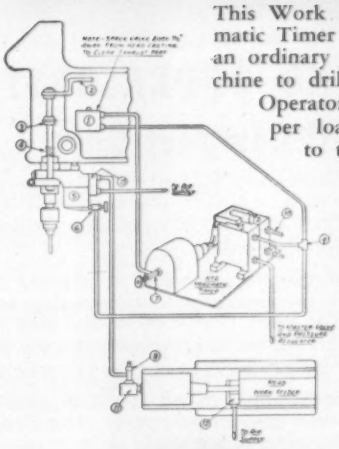
Developed for use in textile, electroplating, laundering, brewing, chemical and other industries in which quantities of aqueous solutions must be reclaimed or continuously analyzed, control device is called the Aquanalyzer. The device is an indicating system that compares the electrical resistance of water entering a tank with the resistance of water being released from the tank after use in a manufacturing operation. When the resistance of influent and effluent are equal, the Aquanalyzer actuates a relay and another operation can be automatically started. The control may be preset to operate at any desired differential or to any specific resistance setting. A continuous sampling of the fluid's resistance is obtained through use of conductivity cells placed at influent and effluent points. These cells transmit resistance readings to a central electronic control point where the readings are quantitatively analyzed and compared and where control of the device is centered.

The cells are free of any plating tendencies and are not affected by any other electrical currents in the solution such as may be encountered in a plating tank. The control units are self-contained and may be wall mounted. **Control Circuits Inc.**, 103 Court St., Middletown, Conn.

Circle 467 on Inquiry Card

AUTOMATION WITH AIR POWER





This Work Feeder, with the aid of a Meadmatic Timer and Drill Press Feed, transforms an ordinary drill press into an automatic machine to drill twin holes in Chain saw links. Operator merely keeps the vertical hopper loaded—the machine delivers them to the drills, holds them firmly and ejects them when finished. Material is tough alloy steel, ranging in thickness from 1/8" to 1/4". Hole spacing is held to 0.0005" by bushings mounted in plate with micro adjustment. Production is 600 to 900 per hour, depending on thickness.

Write for free illustrated booklet of 44 "Examples in Air Power Automation".

MEAD SPECIALTIES COMPANY

4114 North Knox Avenue, Dept. A-37, Chicago 41, Ill.

PATHFINDER IN AIR POWER AUTOMATION

Circle 614 on Inquiry Card

DETREX DEGREASING SUPERIORITY

Available in Small Compact Unit

Now Detrex offers you unexcelled degreasing efficiency and capacity for 600 lbs. of steel parts per hour in a compact, standard unit that occupies less than 10 square feet of floor space! It is absolutely the best buy in degreasing equipment on the market today.

Manually operated, this mighty little vapor-spray-vapor degreaser removes waxes, oils, grease and other processing soils thoroughly and effortlessly from small to medium size parts. Parts in basket can be handled by hand or with a small hoist. All parts are removed from the Cadet clean, warm and dry . . . ready for finishing or further processing.

For laboratories, low production departments in all types of plants, garages—in fact for anyone who needs to clean metal parts—**the Cadet brings the economy of Detrex degreasing completely within reach.**

Send for new bulletin which gives full details on this new unit. No obligation at all.

Please rush me your literature on the new Detrex Cadet Degreaser.

NAME_____

COMPANY_____

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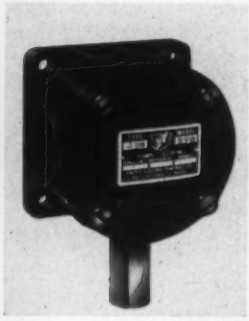
CITY_____ ZONE____ STATE_____

Dept. A-1219

DETREX CHEMICAL INDUSTRIES, INC.
BOX 501, DETROIT 32, MICHIGAN

DEGREASERS • DEGREASING SOLVENTS • WASHERS • ALKALI AND EMULSION CLEANERS • PHOSPHATE COATING PROCESSES

Circle 615 on Inquiry Card

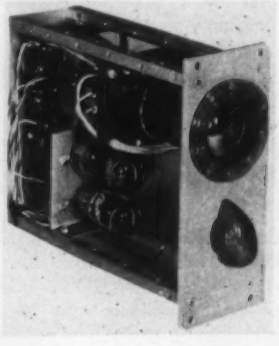


Pressure-Vacuum Control

Designed to provide an accurate method of controlling pressures, Type J95 pressure-vacuum control device can be used in locations where explosive vapors or gases are present. The controller is an uncalibrated unit and pressure settings are made by means of an internal adjusting nut. Models are available with a variety of adjustable ranges between the limits of 0 and 500 psi, and maximum pressures up to 600 psi. *On-Off* differentials between the limits of 2 and 30 psi are obtainable.

The J95 can be supplied with any one of three standard types of switches: Normally open, normally closed, or double-throw with no neutral position. Switches are rated for 15 or 20 amp at 115 or 230v ac. Dc switches are also available. The switch is wired via a ½-inch NPT opening in the enclosure. **United Electric Controls Co.**, 79 School St., Watertown, Mass.

Circle 468 on Inquiry Card



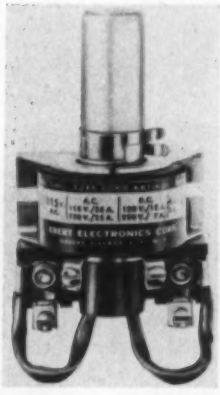
Totalizing Device

Model 166 plug-in strip for totalizer applications provides an ac-

curate register in programs involving velocities, pressures, temperatures, flow rates, viscosities, gages, lineal measurements, sheet countings, stacking counts, cutting counts, batchings and other processes where speeds are too great for mechanical counters. Unit has a scale factor from 1 to 10, maximum speed of 4 kc and resolution of 250 microseconds.

Input requirements are: Minimum amplitude of 15v, minimum rate of rise of 1v per microsecond and minimum pulse width of 100 microseconds. Input impedance is 220 K. Power requirements range from 400v dc at 0.5 ma to 6.3v ac (−125v dc) at 0.6 amp. **Baird Associates-Atomic Instrument Co.**, 33 University Rd., Cambridge 38, Mass.

Circle 469 on Inquiry Card



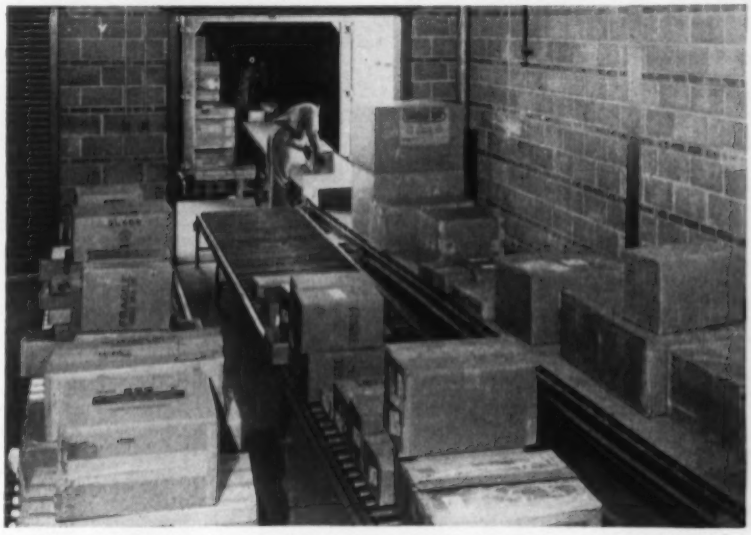
Accident Proof Relays

Specifically designed to withstand shocks, blows and physical impact, line of accident proof armored mercury plunger relays has hermetically sealed, mercury-to-mercury action contactor tubes potted in special high temperature material and plastic coated, aluminum shells. Standard 35-amp or heavy duty 60-amp models are available. Illustrated model, the single-pole single-throw HDC-1, is used for all loads up to 60 amp at 115v ac.

The relay tubes are themselves very durable, and provide the advantage of visual inspection. The tubes are made of tempered heavy Nonex and double-dipped in plastic shatter proofing material. For corrosive atmospheres the relay coils are also available in all stand-

OVER 50 YEARS of Engineering and Manufacturing Experience

make MATHEWS CONVEYERS your best buy



A system of roller and belt conveyer handling incoming and outgoing merchandise in a modern mail order depot.

It was over 50 years ago that the first Mathews Conveyers were designed and built—and from that early equipment has come the development of the Mathews **continuous flow** conveying systems of today. In these 50 years Mathews engineers have developed a complete line of gravity and power conveyers and special conveying machinery to serve nearly every class of industry in the United States and Canada. Whatever is required in the way of modern conveying machinery, you'll find that Mathews has it, and that Mathews Conveyers are your best buy.

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MATHEWS CONVEYER COMPANY WEST COAST . SAN CARLOS, CALIF.
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MATHEWS

Fifty Years of Leadership in Mechanized Handling

Circle 616 on Inquiry Card

SIMPLYTROL AUTOMATIC PYROMETERS

For Control of Temperature

10 standard ranges from −200° to +3000° F.

Accuracy 2% (limit of calibration error).

Sensitivity 4 ohms per millivolt.

Cat. No. 4535, size 10" x 6" x 7". Range 0/1000°F, 0/500°C. $135.00

Thermocouple-type automatic pyrometer for controlling temperature in furnaces or ovens and manufacturing processes. Leads between Simplytrol and its thermocouple sensing element may be up to 100 feet or more depending on temperature range and lead wire resistance. Load relay, 5 amperes S.P.D.T. Optional heavy duty relays to 40 A. Either AUTOMATIC control or LIMIT shutoff. An automatic Simplytrol turns heat on and off to hold required temperature. Proportioning effect can be increased or decreased by changing cam on the sensing cycle. With shorter cycles, control more nearly approaches straight line. A limit Simplytrol locks up when the trip point is reached and remains locked until reset. Use limit Simplytrols for monitoring and safety shutoff or alarm.

Cabinet model for wall mounting or portable shown above. To the right is an MFP Simplytrol for flush mounting in a cabinet or control panel. Several other mountings are shown in Catalog 4-A. Send for your copy. **Assembly Products, Inc., Chesterland 27, Ohio.** Phone (Cleveland, O.) HAmilton 3-4436. (West Coast: Box XX, Palm Springs 27, Cal. Phone DHS 4-3133.) Booth 232 Atomic Expo. Booth 3916 IRE Show

Cat. No. 4532-MFP, size 5" x 5½" x 8" deep. Range 0/1500°F, 0/800°C. $127.00

Circle 617 on Inquiry Card

MECHANICAL ENGINEERS

Research and Development

Interesting positions open for mechanical engineers on a wide variety of projects in the following fields:

- **Experimental Stress Analysis**
- **Mechanism Analysis**
- **Machine Design**
- **Servomechanisms**
- **Vibration and Structural Dynamics**

B.S. to Ph.D. in Mechanical Engineering with 3 to 5 years' experience in one of these fields essential. These are permanent positions offering an opportunity to use your initiative and creative ability. We offer excellent employee benefits including tuition free graduate study. For employment application, call Calumet 5-9600, or write

Mr. J. A. Metzger

ARMOUR RESEARCH FOUNDATION

of

Illinois Institute of Technology

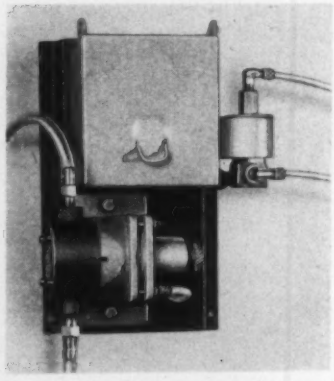
10 West 35th Street

Chicago, Illinois

Circle 618 on Inquiry Card

ard operating voltages, fully enclosed. The relays require no more than ordinary enclosures in most applications. The devices are available in a variety of one, two and three-pole models. **Ebert Electronics Corp.,** 212-30J Jamaica Ave., Queens Village 28, N.Y.

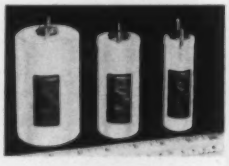
Circle 470 on Inquiry Card



Diaphragm Type Feeder

Developed for safe handling of concentrated chemicals directly from shipping containers, well mounted diaphragm feeder is designated Model 19130. Pumping rates from 0.8 to 8.0 gal per 24-hour period are adjustable by varying the stroke length and stroking frequencies. Reaction time is decreased, and accuracy is within ±5 per cent over a 5 to 1 range. **Proportioneers Inc.,** 345 Harris Ave., Providence, R.I.

Circle 471 on Inquiry Card

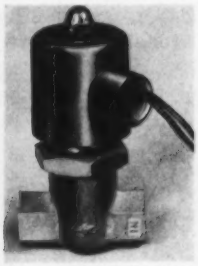


Circuit Components

Designed as building blocks which can be used to assemble many basic circuits for fast response and high gain, Maximag magnetic amplifier circuit components are available in up to 300w capacity models. The magnetic amplifier circuit components are used in servoamplifiers, regulator amplifiers, torque motor controllers, dc power supplies, static relays and binary switches.

Three basic sizes are available to cover the range of 1.5 to 300w, 60 cycles and 400 cycles. The largest unit, rated at 300w at 400 cycles measures only 2 7/16 inches in diameter by 4 1/16 inches in height. The circuit components feature ½-cycle response, three control windings, two matched cores, high impedance input, low impedance output, and an operating range from −55 to 71C. **Adler Electronics Inc.,** One LeFevre Lane, New Rochelle, N. Y.

Circle 472 on Inquiry Card



Solenoid Valve

Designed for air pressures up to 100 psi, the Electroflo solenoid valve is available with a full ⅜ or ¾-inch orifice. Continuous-duty solenoids are available from 6v dc to 440v ac. Overall length of the ⅜-inch valve is 2 17/32 inches; the ¾-inch valve is 3¾ inches. The inlet center to top dimension of the ⅜-inch valve is 4⅜ inches; the ¾-inch valve is 5 1/32 inches. Coil diameter of either size valve is 2 inches. **Hays Mfg. Co.,** Dept. No. 326-A, W. 12th St., Erie, Pa.

Circle 473 on Inquiry Card

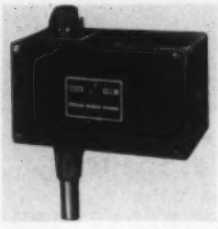
Insulated Hook-Up Wire

Designed primarily for use in electrical appliances, in distribution and power transformers, aircraft, integral and traction motors, and for use in chemical applications to meet extremes of corrosive conditions, teflon insulated hook-up

wire is available in sizes 16 to 28. The teflon coated, silver plated copper wire has a low power factor, low dielectric constant, high volume and surface resistivity and good dielectric strength. The covering of teflon insulation is in thicknesses of 0.010 to 0.015-inch.

Wire is capable of continuous service to 260C; it is flexible over a wide temperature range, even down to −265C. The wire conforms well to odd shapes and sharp corners because of good elongation. It is inert to all chemicals and solvents, except molten alkali metals, and fluorine at elevated temperatures and pressures. **Haveg Industries Inc.**, 900 Greenbank Rd., Wilmington 8, Del.

Circle 474 on Inquiry Card



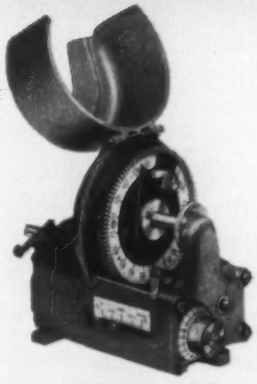
Temperature Control

Offered as a dual switch unit, local mounted temperature control can often substitute for two separate single-switch controls. In the Type B27A unit, the immersion element (bellows housing) is placed directly into the medium that is to be controlled. Variations in the temperature of the medium are converted to a force that causes the bellows plunger to operate the two switches.

The control head has an external range adjustment with a calibrated scale, and temperature settings are made by rotating a single-turn knob and pointer to the desired point on the scale. Models with ranges of 50 or 100F between limits of 30 and 400F are available. An internal adjustment screw on each switch makes it possible to adjust for a maximum span of approximately 20F between switch settings. The control may be mounted in any position by means of the ½-inch NPT on the immersion element. **United Electric Controls Co.**, 79 School St., Watertown, Mass.

Circle 475 on Inquiry Card

COUNT-REGULATED CIRCUIT CONTROL WITH AUTOMATIC RECYCLING

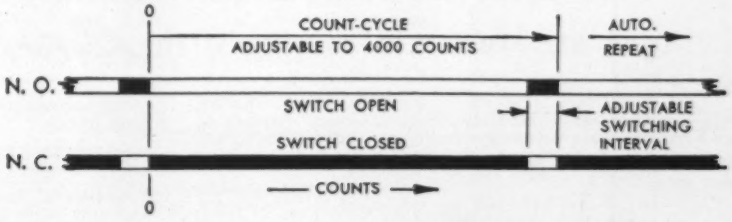


CYCLO-MONITOR
Write for Bulletin 202-1

CYCLO-MONITOR

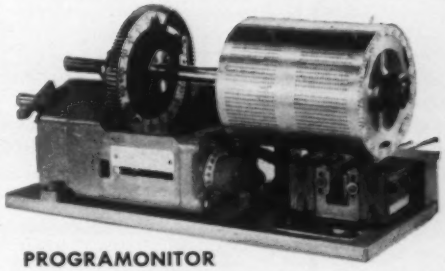
COUNTS: Shaft Revolutions
Lever Strokes
Electric Impulses

CONTROLS: Machines and processes on a repeat cycle basis. No reset required. No pause or lag in recycling—even at continuous speeds. Positive gearing throughout. Integral, SPDT switch transfers as shown in typical cycle diagram below:

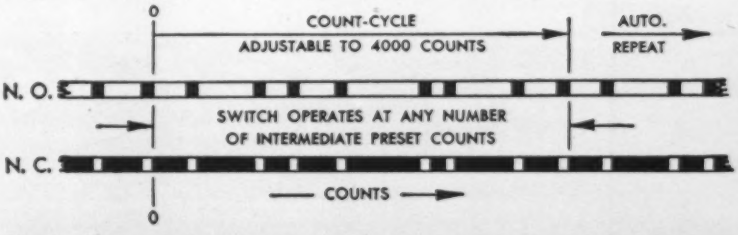


PROGRAMONITOR

An advanced recycling, circuit-controlling counter for complex and irregular switching patterns with any number of intermediate switching points. Complete flexibility for pattern changes. Automatic, instantaneous recycling.



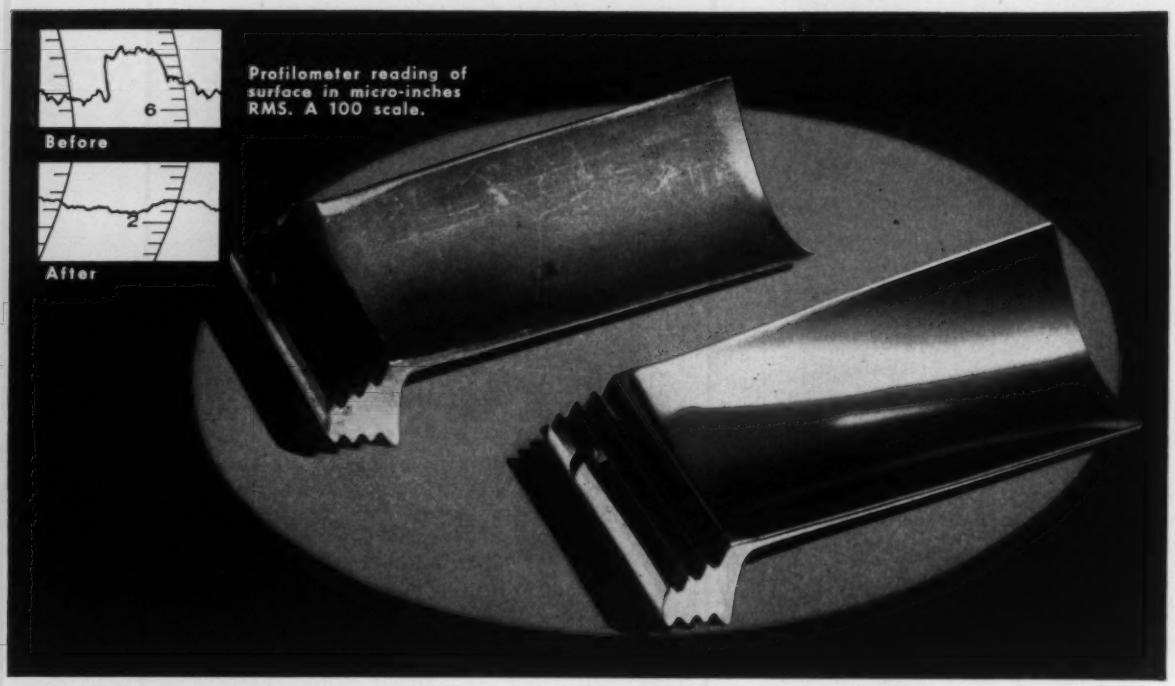
PROGRAMONITOR
Write for Bulletin 505



COUNTER AND CONTROL CORPORATION

5233 W. ELECTRIC AVE. • MILWAUKEE 19, WIS.

Circle 619 on Inquiry Card



Cut parts finishing costs, maintain exact tolerances, get absolute uniformity with *Roto-Finish* processes

Roto-Finish, pioneers in precision barrel finishing, offer you a complete finishing service. Savings on deburring, descaling, grinding, polishing, coloring and surface improvement are tremendous. Expensive hand finishing methods can be eliminated.

Roto-Finish processes are controlled to produce the finish you need with no significant dimensional changes. You get absolute uniformity of finish in quantity lots.

Many prominent manufacturers now using Roto-Finish processes are saving money on finishing costs. (Names on request).

ROTO-FINISH CHIPS, COMPOUNDS AND MACHINES ARE OF THE HIGHEST QUALITY Roto-Finish has never sacrificed quality for the sake of price. Through the years, Roto-Finish has carried on a continuous program of process and product improvement to meet the needs of modern industry. When you choose Roto-Finish processes, you can be sure that you are getting the best in supplies, equipment and complete continuing engineering service.

ROTO-FINISH GUARANTEES RESULTS

There is no costly trial and error involved in the purchase of Roto-Finish equipment. You submit unfinished parts to Roto-Finish along with a finished sample and a description of the finish you require. These sample parts are processed in the Roto-Finish Sample Processing Laboratories, where experienced engineers determine the combination of chips, compounds, and machine required to do the job. Roto-Finish guarantees to reproduce the same results in your plant, using the Roto-Finish processes, that are achieved in sample processing. This service demonstrates for you exactly what you can gain by using Roto-Finish processes.

The sample processing service is available to help you with your finishing problem. Take advantage of this opportunity to save on finishing costs. Send samples of finished and unfinished parts and details of the type of finishing equipment available in your plant.

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It describes the basic process, chips and compounds and the complete Roto-Finish line of standard and special machines.

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ENGLAND — Roto - Finish Limited — Mark Road, Hemel Hempstead — Hertfordshire
FRANCE — Societe Roto - Finish — 40-42 rue Chance Milly — Clichy (Seine) — Paris
GERMANY, AUSTRIA, NORWAY, SWEDEN, SWITZERLAND — Metallgesellschaft A. G. — Reuterweg 14 — Frankfurt a. M. — Germany.
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SPAIN — Instituto Electroquimico, S. A. — Corcega 58 — Barcelona

catalogs and literature

Latest automation information. For copies use card page 17.

Air Powered Pumps

Gray Co. Inc., 1045 *Sibley St. N.E., Minneapolis* 13, *Minn.*—44-*page catalog*—Used for paint circulating systems, viscous material transfer, extrusion applications and spraying, Powerflo reciprocating pumps and equipment are discussed in Catalog No. 453. Air-powered units can pump materials ranging from light fluids to the most viscous materials. Four series of pumps in varying power ratios are available.

Circle 476 on Inquiry Card

Instrumentation Catalog

Fischer & Porter Co., 907 *Jacksonville Rd., Hatboro, Pa.*—32-*page catalog*—Line of customized process control instrumentation for transmitting, indicating, recording, and controlling flow, pressure, density and chlorination is discussed in Catalog 2. Line of products is available for immediate shipment. Catalog includes prices, instrument weights, specifications, operating characteristics, photographs and sizing nomographs.

Circle 477 on Inquiry Card

Gravity and Power Conveyors

Standard Conveyor Co., N. St. Paul 9,*Minn.*—32-*page catalog*—Developed for more rapid handling of unit materials in warehouses, shipping platforms, yards, and various plant operations, line of 12 standardized conveyor types is discussed in Bulletin No. 64. Straight and curved section roller conveyors, wheel conveyors, belt conveyors, switching units, drive units and belt elevators are among the types covered. Numerous photographs, specification tables and operating data are included.

Circle 478 on Inquiry Card

Automated Grinding

Gardner Machine Co., Beloit, Wis.—8-*page bulletin*—Automatic hopper feed, loading and unloading, size gaging and diamond dressing are among the automatic features shown on a Model 2H30 grinder illustrated in Gardner Grinder for Nov. 1956. User production reports on two similar model machines are included. Production data on bonded disks and Model 2V18 vertical spindle is also given.

Circle 479 on Inquiry Card

Machine Tool Tape Control

Electronic Control Systems Inc., 2136 *Westwood Blvd., Los Angeles* 25, *Calif.*—12-*page bulletin*—Applicable for numerical control of such machine tools as milling, turning, contouring and grinding units where the cutting tools are guided along a continuous path to produce a desired part, Digimatic system is the subject of illustrated bulletin. Magnetic tape control unit comprises a planning desk, a high speed special purpose computer and a machine control unit. Photographs and operating data are included.

Circle 480 on Inquiry Card

Magnetic Separators

Jeffrey Mfg. Co., Columbus 16, *O.*—16-*page booklet*—Designed to solve wet concentration and magnetic recovery problems, drum type magnetic separators are illustrated and described in Catalog 910. Installation photographs show actual applications of the units. Six magnetic separator types are discussed in the booklet, with specifications and operating data included.

Circle 481 on Inquiry Card

Variable Speed Motor Pulleys

Worthington Corp., Harrison, N. J.—8-*page bulletin*—Available for operation from ⅛ through ¾ hp, line of motor pulleys is discussed in Bulletin #1630-B1 P. Photographs and descriptions of adjustable and tilting motor bases and companion sheaves are included. Ratings, dimensions and selection data for the variable speed motor pulleys are given in chart form.

Circle 482 on Inquiry Card

Diecasting Machinery

Hydraulic Press Mfg. Co., Div., Koehring Co., Mt. Gilead, O.—18-*page booklet*—Line of cold chamber diecasting machines from 200 to 800 ton capacity is described in Bulletin No. 5700. Machine features improved designs of self-contained clamp and ejection ends. Large cutaway photograph illustrates construction features of the machine. Specifications, standard and optional features are noted, along with installation pictures of the machines.

Circle 483 on Inquiry Card

Relays and Switches

Jaidinger Mfg. Co., 1921 *W. Hubbard St., Chicago* 22, *Ill.*—12-*page bulletin*—Approximately 40 different switches and relays, ranging in size from standard to miniature, are illustrated and discussed in bulletin. Miniature, one to three-pole relays; small general purpose, one to five-pole relays; and multicontact relays are among the types covered. Double and single-snap switches and stack switches are also described and pictured.

Circle 484 on Inquiry Card

Strip Thickness Control

Industrial Nucleonics Corp., 1205 *Chesapeake Ave., Columbus* 12, *O.*—12-*page bulletin*—Developed for use by the metalworking industry, line of AccuRay strip thickness control systems is the subject of Bulletin #B 1556. Automatic strip thickness control of ferrous and nonferrous tandem and reversing cold mills, measurements of zinc and tin coatings, and systems for classifying and assorting lines are discussed. System components are illustrated; installation photos are also included.

Circle 485 on Inquiry Card

Tape Recorder

Instrumentation Div., Ampex Corp., 934 *Charter St., Redwood City, Calif.*—20-*page booklet*—Used in machine and process programing, data acquisition, storage, analysis and reduction and in dynamic simulation, FR100 instrumentation tape recorder is the subject of illustrated booklet. Illustrations show transports, heads and modular electronic assemblies used in the recorder. Specification information and application data are included.

Circle 486 on Inquiry Card

Power Pickup

Electro Products Laboratories, 4501 *N. Ravenswood Ave., Chicago* 40, *Ill.* —1-*page data sheet*—Self-generating power source for direct operation of over and underspeed controls or warning devices is described and illustrated. Specifications, operating characteristics and circuit diagram of the Model 3040 power pickup are included.

Circle 487 on Inquiry Card

Electronic Weld Control

Sciaky Bros. Inc., 4915 *W. 67th St., Chicago* 38, *Ill.*—10-*page bulletin*—Absolute weld consistency and positive reproducibility are results of three-phase Modu-Wave principle of operation for which predetermined electronic counter weld control is designed. Control combination and individual chassis available for spot welders, seam welders and roll spot welders are listed. Six control-equipped welder models are illustrated; standard and optional welder features are noted.

Circle 488 on Inquiry Card

Hopper Feeders

Haberstump - Harris Inc., 10463 *Northlawn Ave., Detroit* 4, *Mich.*—8-*page bulletin*—Sliding action Hopperal feeders used in assembly, inspection, gaging, packaging, processing, production loading, etc. are described in illustrated bulletin. Single and double-track models are shown, and a parts feeder selection chart is included.

Circle 489 on Inquiry Card

Collapsible Box Workbook

International Paper Box Machine Co., 315 *Main St., Nashua, N.H.*—72-*page handbook*—Comprehensive discussion on nomenclature, collapsible box types, boxmaking tools and machines, and proper cutting and creasing of collapsible boxes is given in illustrated handbook. Advantages and disadvantages of plunger, straight line and right angle types of boxmaking machines are listed. Possible box dimensions and sequence of forming operations for 26 styles of boxes formed by two company machines are also described.

Circle 490 on Inquiry Card

Continuous Analyzers

Mine Safety Appliances Co., 201 *N. Braddock Ave., Pittsburgh* 8, *Pa.* —8-*page bulletin*—Completely automatic and continuous in operation, LIRA analyzers which can be used in the control of either continuous or batch processes to determine and control product quality, are the subject of Bulletin No. 0705-2. Analyzers are available in null balance or deflection types. Schematic diagram illustrates principle of operation; photographs and specifications are also included.

Circle 491 on Inquiry Card

Rotary Kiln Instrumentation

Leeds & Northrup Co., 4934 *Stenton Ave., Philadelphia* 44, *Pa.*—16-*page booklet*—Used in the manufacture of cement, lime and other nonmetallic products, line of rotary kiln instruments and controls is described in Folder N-0720(1). Titled "Modern Practices in Rotary Kiln Instrumentation," the booklet contains photographs and descriptions of automatic equipment for temperature control, pressure control, speed control and oxygen analysis, and includes a view of a graphic control panel said to be a "first" for rotary kilns.

Circle 492 on Inquiry Card

Automatic Controls

Mercoid Corp., 4201 *Belmont Ave., Chicago* 41, *Ill.*—58-*page catalog*—Used for heating, refrigeration, air conditioning and industrial applications, line of mercury switch equipped automatic controls is the subject of Catalog No. 857. Single and two-stage pressure, differential pressure, single and two-stage temperature, liquid level and mechanical movement controls are illustrated and described. Also shown are relays and a complete line of mercury switches.

Circle 493 on Inquiry Card

Relay Selection Guide

Potter & Brumfield Inc., Princeton, Ind.—12-*page bulletin*—General purpose relays, telephone type relays, sensitive relays and other types are illustrated in bulletin which describes each kind and its application. Ratings and configurations for contacts, coils, terminals, enclosures, dimensions and mounting data are noted for the various types. Other company products, actuators, stepping switches and shaded pole motors are mentioned.

Circle 494 on Inquiry Card

Flexible Couplings

Industrial Sales Div., Morse Chain Co., Ithaca, N. Y.—24-*page catalog*—Designed to transmit power smoothly, isolate vibration, absorb shock loads and compensate for dimensional misalignment, line of Morflex couplings is discussed in Catalog C 41-56. Use of preloaded rubber biscuits for power transmission with torsional flexibility is explained and illustrated. Dimensions and specifications on standard, double and radial type couplings are given, along with data on driveshaft assemblies.

Circle 495 on Inquiry Card

Millivoltmeter & Microammeter

Manning, Maxwell & Moore Inc., Industrial Controls Div., Stratford, Conn.—8-*page bulletin*—Strip or card recorders for low level dc electrical measurements are discussed in Bulletin MG10. Principle of operation, design and operating features are covered. Diagram showing dimensions, design specifications and ordering information are also included.

Circle 496 on Inquiry Card

Industrial Data Systems

Consolidated Electrodynamics Corp., 300 *N. Sierra Madre Villa, Pasadena, Calif.* — 20-*page booklet* — Dynamic and static testing, chemical analysis and process control, high vacuum technology, and automatic data processing are basic industrial activities which CEC systems are designed to handle. Application photographs and case studies contain information on practical solutions to a wide variety of problems.

Circle 497 on Inquiry Card

Power Conveyors

Harry J. Ferguson Co., 149 *West Ave., Jenkintown, Pa.*—24-*page catalog* — Application photographs are used to illustrate line of power conveyors described in Bulletin 302. Apron conveyors; horizontal and inclined belt conveyors; portable belt boosters; floor to floor belt conveyors; power belt corners; dairy chain conveyors; barrel, keg and sack elevators; live roller conveyors; reciprocating hoists; and special chain and belt types are covered.

Circle 498 on Inquiry Card

Synchro Devices

Ford Instrument Co., Div., Sperry Rand Corp., 31-10 *Thomson Ave., Long Island City* 1, *N. Y.*—12-*page bulletin*—Available as transmitters, receivers, control transformers and differential units, line of Telsyn synchros is discussed in bulletin. Transmitter receiver systems reproduce shaft rotations at remote points; transmitter-control transformer systems produce voltages measuring displacement of the control transformer shaft relative to that of the transmitter; and with differential units, the rotation of the receiver shaft represents the sum or difference of the rotations of the transmitter and the differential. Specifications and dimensions of the synchros are given.

Circle 499 on Inquiry Card

Rotary Gear Pumps

Northern Ordnance Inc., Dept. 106, *Columbia Heights Station, Minneapolis, Minn.*—14-*page bulletin*—Used for transportation and industrial applications, Nitralloy steel block pumps

are described and illustrated. Rotary gear pumps are used with oils, propane, ink, asphalt, molten lead, etc. Detailed performance and engineering data on the pumps as well as general conversions and information are included.

Circle 500 on Inquiry Card

Can Machinery

E. W. Bliss Co., 50 Church St., New York 7, N.Y.—8-page bulletin—Automatic strip feed presses in medium and high speed models, automatic curlers and stacking machines are described in Catalog 36B, Section 2. Photographs illustrate each type of can machinery; specifications of several models are included.

Circle 501 on Inquiry Card

Air Control Valves

Airmatic Valve Inc., 7317 Associate Ave., Cleveland 9, O.—72-page catalog—Two, three and four-way air control valves for high or low pressure installations are described and illustrated in catalog. Single and double-acting cylinders for air or hydraulic use and strainers for pipeline protection are also presented. Application data, dimensions, specifications and parts breakdown are included.

Circle 502 on Inquiry Card

Overhead Materials Handling

Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, O.—12-page bulletin—Carriers for automatic, hand and electric operation; track switches; standard cranes, transfer cranes and gantry cranes; safety electrification; buckets and grabs are described and illustrated in Booklet No. 2008-M. Principal components of overhead materials handling systems are discussed, and formulas for comparing various track designs are included.

Circle 503 on Inquiry Card

Armored Cables

National Electric Products Corp., Gateway Center, Pittsburgh 22, Pa.—24-page catalog—Written as an aid for those who specify electrical systems for new and old electrical facilities, illustrated catalog is designated A.I.A. File No. 31-C-67. Photographs and descriptions of various types of Nepco-Lok armored cables, single and multiconductor, available for potentials as high as 15,000v, are included. Data for each type, including conductor size, stranding, insulation, sheath and armor thickness, approximate outer diameter and weight per thousand feet is given in chart form. Fittings for terminating and splicing armored cables are also described.

Circle 504 on Inquiry Card

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At initial equipment cost under $4,000

The above photo shows a three-stage Magnus Aja-Lif cleaning setup used for cleaning aircraft component parts. Performed here are three operations:

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Circle 621 on Inquiry Card

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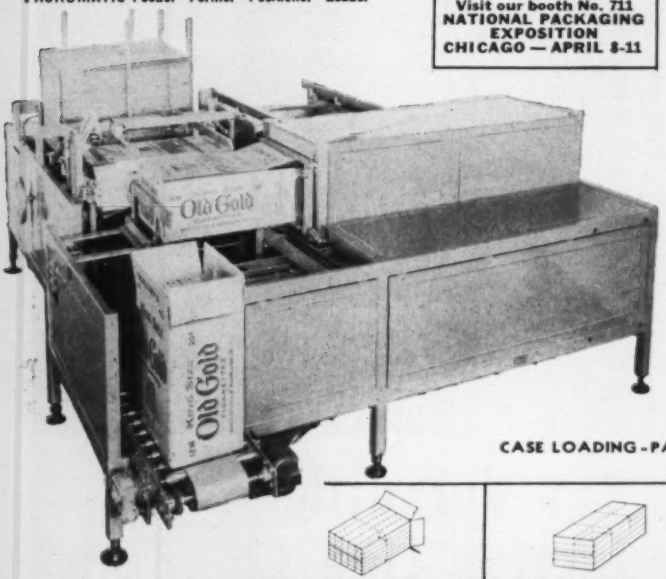

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Here's a fully automatic case Feeder-Former-Positioner-Loader that is breaking records on actual production line conditions in a variety of industries. And by end-loading techniques, savings on paper board alone run as high as 28%. Production jumps dramatically with this high-speed, continuous-motion machine. Labor costs are lower, too, because except for hand-stacking corrugated shipping containers in flat form into the magazine, everything's automatic. Below are some of the end-loading patterns showing number and packing of cartons. Check with Packomatic engineers if your loading pattern does not appear here. Custom-engineering will produce a Packomatic for your product.

CASE LOADING-PATTERNS:

Twenty-four cartons in 12½" x 10⅝" x 8½" case

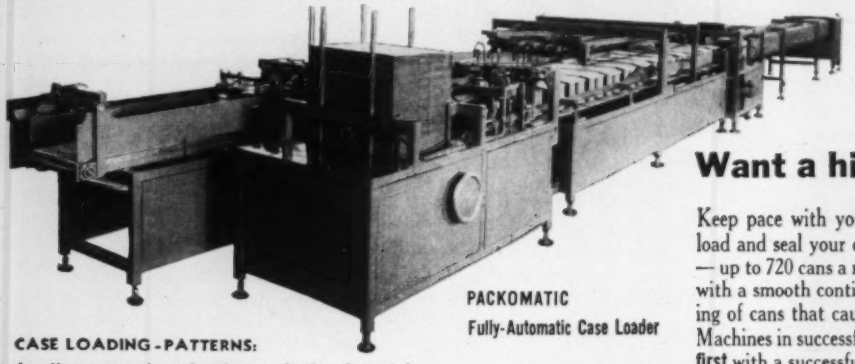
Eighteen 7 & 8 oz. cartons in 20" x 14⅞" x 8⅝" case

Sixty cigarette cartons (reg. & king-size) in 21 1/16" x 17⅞" x 11⅜" case

Thirty 1 lb. cartons in 16⅛" x 10 5/16" x 7¼" case

Twenty-four cartons in 19½" x 10⅞" x 7" case

Forty-eight cartons in 22¾" x 23½" x 15⅞" case



PACKOMATIC
Fully-Automatic Case Loader

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handles any can from the 12 oz. to the 5-qt. Imperial

Six 5-qt. cans or gallon cans in 20⅛" x 13⅝" x 9 3/16" case

Twelve 46 oz. cans in 21" x 13" x 7⅛" case

Twenty four 12 oz. cans in 16⅜" x 10 5/16" x 5 5/16" case

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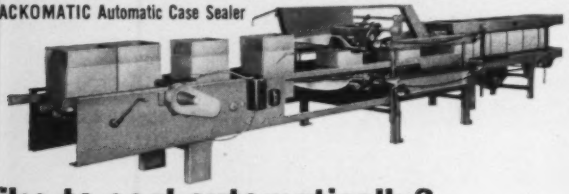
Want a high speed can line?

Keep pace with your production line. Now, feed-form-position-load and seal your corrugated shipping containers at high-speeds — up to 720 cans a minute — automatically. This is accomplished with a smooth continuous motion to eliminate jarring and bumping of cans that causes leakers and mars labels or lithographing. Machines in successful operation across the nation Packomatic was **first** with a successful production-line machine) end-load a variety of can sizes — from six 5-quart cans to twenty-four 12-oz. cans — in such patterns shown at left. End-loading reduces paper board costs. Automation saves labor costs. From corrugated flats to sealed containers, only one part-time attendant is required. Consider this time-money saver for your plant. We can custom-engineer a machine like this for you.

PACKOMATIC Automatic Case Sealer



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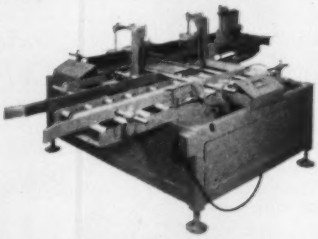

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REDESIGN PERMITS AUTOMATIC ASSEMBLY

By DAVID H. ESPERSON
Manufacturing Engineering Section
Electronics Div., General Electric Co.

OUR EXPERIENCE with the production of small choke coils can serve as a classic example of the interrelationship between design and successful automatic manufacture and assembly. Without suitable product design, automation is extremely difficult, if not impossible, and can rarely, if ever, be economically justified. Many redesign programs will result in a lowered material cost as well as a reduction in manufacturing and assembly labor.

The coil in question is a very common one in television receiver sets. It is used as a video compensating choke. The winding itself varies from 5/16-inch to 11/16-inch OD. Number of turns vary from 30 to over 400. A number 36 AWG wire (0.005-inch) is used. The old style coil consisted of a winding on a small paper coil form. The form was slipped over a dummy resistor whose sole function was to provide connection leads for the coil, the winding wire being too fragile for this purpose. The coil was wax impregnated for moistureproofing and wax flashed for protective purposes.

Before Automation

In the old manufacturing process, coils were wound on a Universal winder, four at a time. The operator had to secure the end of each of the windings before starting the winder. At the end of the winding cycle, a dab of acetate cement had to be applied to the outside of each coil to prevent unwinding when the feed wires were cut and coils unloaded. After wax impregnation the coil was assembled to the dummy resistor. The coil was slipped over the resistor, which had just previously been dipped into a wax pot. Upon cooling, the wax secured the form to the resistor body. The coil leads were then untangled and twisted around the dummy resistor leads. Extreme care had to be exercised not to get the coil leads too taut or they would break when the dummy resistor leads were formed during the assembly of the component in the final product. This was the weakest part of the coil design and the cause of over 90 per cent of the rejects of this component in the final product manufacturing process.

In soldering the leads, the operator would hold the assembly by one lead and dip the opposite one into a solder pot up to the body of the resistor. This was repeated for the other lead. By maintaining the solder at around 900F, the insulation on the winding wire was burned off and a connection made. The whole coil was then dipped into a pot of Zophar 1340 wax to protect the fine winding wire and to further exclude moisture.

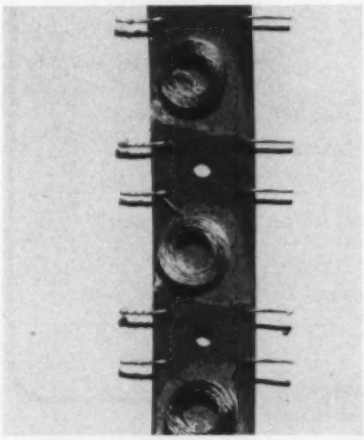

Fig. 1—New design of choke coil mounted on fishpaper backing tape showing indexing holes and wire staples.

The choke coils were cut and formed prior to delivery to the assembly lines. To minimize the reject rate of TV sets due to open choke coils, every operator assembling these coils performed a continuity check just prior to assembly. Loss rate at this check was approx. 4 per cent.

Improved Method

A cost reduction program was started, which grew to include an automation program. The result was a totally new design of coil. This new design consists of a 0.025-inch thick fishpaper backing tape, No. 23 W&M gage (0.026-inch), tinned bookbinders' wire and a coil wound of polyurethane film cellulose acetate wrap wire, *Fig.* 1. Coil forms are unnecessary. The coil is wound on a bare spindle. It is then moistened with acetone. The acetate serving on the wire is momentarily dissolved and adjacent turns fuse to each other. When the acetone evaporates, the coil has become a solid self-supporting unit. In fact, it can practically be bounced off the floor without damage. The polyurethane film, being impervious to acetone, precludes shorting of turns.

By using a fly winder, continuous and automatic winding is achieved. Multiple spindles, mounted on a turret, are successively indexed into position opposite a winding fly, *Fig.* 2. The wire is fed through the hollow shaft which rotates the fly and out through an eyelet or slot at the tip of the fly. The fly itself, which guides and positions the wire, oscillates

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AUTOMATION

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back and forth along the axis of its shaft to lay the wire in the desired pattern. Winding speeds are in the order of 1800 rpm. When a winding has been completed, the spindle turret is indexed, removing the completed coil and positioning a bare spindle for the next winding cycle. The finish lead of the completed coil not having been cut, the wire is pulled through the fly during index, is still secure and becomes the start lead of the next winding. This also prevents the first winding from unraveling at this point. In this new position, the first winding can be sprayed with acetone to fuse the acetate serving. At the next index of the turret, following the spraying of the second coil, the connecting lead between the two coils can safely be cut and the first coil stripped from the spindle. In this way continuous winding is obtained, since the need for

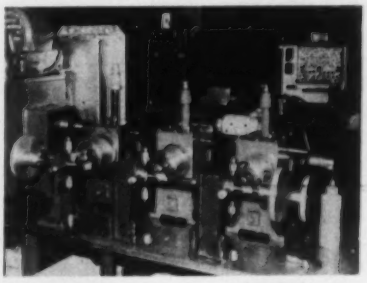


Fig. 2—Winding equipment on which coils are wound continuously and automatically.

securing start and finish leads is eliminated. This completes the winding phase of the operation.

The backing tape is received in continuous strips of several hundred feet, wound on reels. It is fishpaper, 0.025-inch thick and 11/16-inch wide. Pilot holes (⅛-inch diam) are punched on 1⅛-inch centers. These are used for indexing and positioning in the subsequent operations. The tape is rereeled after punching.

The next operation is the addition of staple leads. A standard Bostitch stapling machine is used, which makes the staples from reels of the tinned bookbinders' wire. The tape is indexed by means of a special ratchet device which engages the previously punched pilot holes to insure accurate spacing of the staples. The legs of the staples are bent outward, instead of towards each other, extending

beyond the edges of the tape. The tape is again rereeled following this operation.

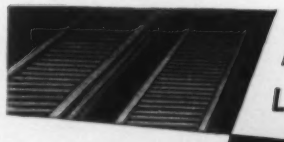
The windings are now applied to the tape. This is currently being done manually, *Fig.* 3. The stapled tape is unreeled from the right and fed through the press. Cement is applied to the tape and the windings positioned thereon. The air operated clamp press is closed, holding the coils in place while the cement dries and the operator twists the winding leads around the staples. Excess winding lead length is snapped off. Ten coils are positioned during each cycle. Lead twisting time is then sufficient to allow the cement to dry. The completed assembly is then rereeled.

Next, the ends of the staples around which the coil leads were wrapped are first dipped into flux and then passed through a solder pot in a special machine setup,

Fig. 3—Coil windings are positioned on tape and held in place by press as cement dries.

Fig. 4. The heat of the solder burns off the acetate serving and polyurethane film to permit a soldered joint. A rubber stamp wheel rides against the back of the tape applying a suitable code number. The wheels which drive and guide the coil strip through the flux and solder pots have tapered pins which extend radially around their periphery and engage the pilot holes in the backing tape. This insures accurate immersion of the staple lead during fluxing and soldering.

The final step in the manufacture of this choke coil is wax impregnation. The rereeled soldered assembly is placed in a Barrett centrifuge for this operation, which is done merely to moistureproof the backing tape. The coil itself is sufficiently fused to preclude deleterious moisture absorption. Since the coils are protected



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by the reel, there is no chance for damage during the centrifuging.

The coils are currently being hand placed into printed wiring boards. For this use, the reels are fed through an automatic cutter. The coils are indexed into position, again by means of the pilot holes, and an air operated blade severs the coils into individual units which drop into pans for delivery to the television assembly lines.

No cutting or forming of leads is required prior to use. The holes into which the coils are placed are located according to the spacing at the staples on the backing tape. Furthermore, the unused ends at the staples are placed through the holes in the printed boards. This not only eliminates the danger of disrupting the previously soldered joint with a second dip, but also permits bending of the assembly leads without danger of breaking the fine winding leads. The assembly leads are crimped on the circuit side of the wiring board to keep the choke coil perpendicular to the board and to insure a good dip solder joint.

Of particular interest is the savings in material cost which amounted to 55 per cent. This compares to a labor savings of 20 per cent. Since this was ostensibly a mechanization and automation project, why the disparity? The full impact of mechanization has as yet not been felt. Further labor savings are available and are scheduled to be achieved. Nevertheless, it is of great interest to see that redesign for automation can also bring about a substantial reduction in material costs.

Future Plans

The future mechanization program for this coil is two-fold. Most imminent is an inserting machine. Drawings are complete and construction is in progress of a machine to take the coil in its strip form, test it and insert it into a printed wiring board. This machine is designed for use on an automatic component placement conveyor which is currently assembling resistors on a production model. The inserting machine or head takes the coil from the reel and indexes it into position between a pair of fingers which grasp it by the staple leads. Here again, the pilot holes insure accurate indexing. The coil is then cut off from the remainder of the reel and inserted through the appropriate holes on the circuit board. A clinch anvil comes up from the bottom and crimps over the protruding leads to secure the coil to the boards. There is a test position just prior to the cut-off station where a continuity check is given the coil. If it proves to be open, the machine double indexes. The cut-off station has a dual shear which can cut the tape to either side of the coil being held by the placement fingers. Thus, the reject coil is severed from the coil to be placed and falls into a discard chute. This insures that only good coils are placed, except in the rare instance when there are two or more adjacent open coils.

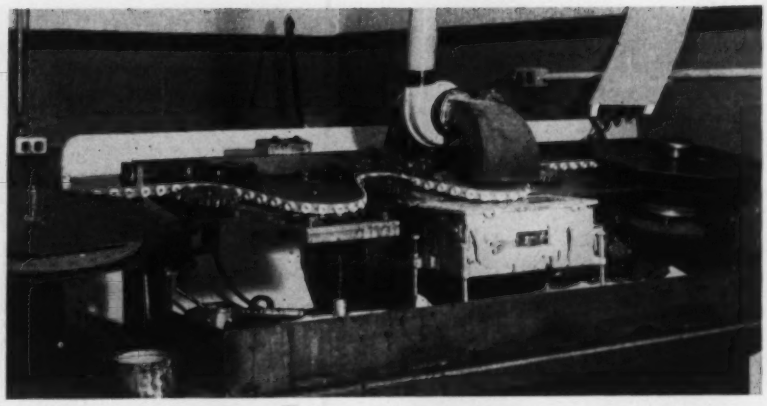

Fig. 4—Marking, fluxing and soldering machine in which identification is printed on back of coil and lead wires are soldered to staples.

The second phase of our future automation program deals with the coil manufacturing process. By indexing the stapled backing tape under the winding arbor turret, the winding can be deposited into position on the tape when it is stripped off the arbor. The tape will be coated with an acetate film on the side the coils are to be attached. A few drops of acetone will cause them to bond—one way of getting around a difficult and messy cement application problem.

Wrapping of the winding leads around the staples will be the only remaining manual operation. It is technically feasible to do this mechanically. However, it is not economically justifiable at this time.

The coils will be passed through an automatic tester which will check them for inductance values. A comparator will be used. Contact will be made with the placement ends of the staples. If the coil proves to be out of tolerance, the staple ends will be cut off when the coil is indexed into the next position. As this coil is indexed into the test station of the placement head, no contact can be made since the placement leads are missing. The machine will indicate an open coil, double index and eject the mutilated part. This method of handling reject coils eliminates splicing the backing tape, an operation which would be required if a defective part were to be cut out of the middle of the reel.

The success of this whole mechanization program is based upon two items: First is the cellulose acetate wrap wire which permits winding without a coil form and eliminates the need for cementing the finish leads. Note that this also offers a material cost reduction. Secondly, the fishpaper tape backing is indispensable to the whole process. Here again, a material cost reduction was achieved. Without the continuous tape with its accurately located pilot holes the automatic feed and indexing used throughout the process would be impossible. The redesign of the product was the key to success.

From a paper entitled, "Automatic Manufacture of a Choke Coil" presented at the Radio Fall Meeting of the Radio-Electronics-Television Manufacturers Association, Syracuse, New York, Oct. 1956.

COMPUTER PROGRAM

By PHILIP A. TOLL
Sperry Gyroscope Co.
Great Neck, N. Y.

BECAUSE OF THE investment magnitude of a computer application program, the penalties involved in such a program if it is poorly managed, and the great potential rewards for sound, rapid progress in utilization of computing equipment for business data handling—a strong case can be made for viewing an application program as a continuing affair, not a "one-shot" process. The program, in all its aspects, should be related to the long-term growth and continued operation of the company undertaking it.

In turn, if this is to be done, a strong theoretical base, a conceptual framework, so to speak, must be provided to support the plan of attack on problems of business data handling throughout a company over a span of years. This theoretical foundation must be related to the project plans and be understood by the top management that approves the program because it is really the theoretical foundation that management should buy, not a computer or any other hardware.

Speed Is Not Improvement

I doubt that I need be concerned here with supporting the premise that these fields of endeavor fall within the province of the management scientist. I want, however, to make one point that I believe should influence the work of a scientific group supporting computer applications. There seems to be increasing general recognition today of the fact that, more often than not, the methods of management are a function of the existing information handling system. However, there is also considerable talk suggesting that the next step from this conclusion is to give top management better, more accurate and timely information as a basis for managing. I submit that the emphasis is on the wrong end of the management scale, if, in truth, it should be on either end. The best way to relieve problems of management at any particular level is to improve the facility with which control of operations is exercised at subsid-

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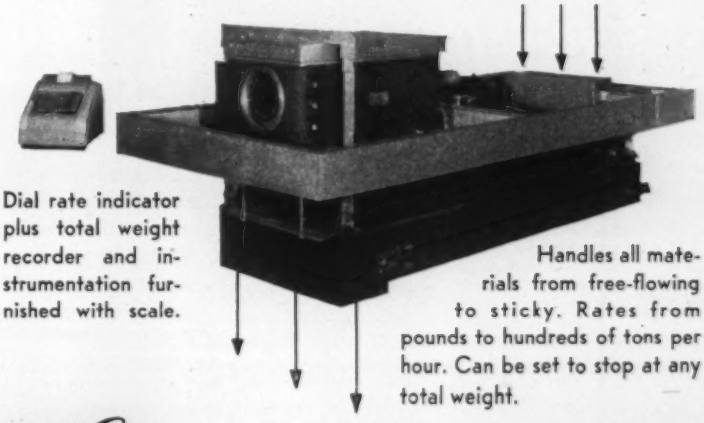

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iary levels. Beyond this, what is needed is an hierarchial information system for, first, indicating deviations from plan, and, second, the importance of such deviations from the manager's viewpoint at each level. An information handling system covering a significant portion of a company's operations and embodying these two elements will represent a significant achievement in any company. Research directed toward attainment of this end is a principal phase of management science work in the context of which I speak.

A principal relationship of the research group is that with existing line and staff organizations of the company, other than those directly committed to the computer application program. Necessarily, most concern is concentrated on those other departments whose established functions and responsibilities are affected, directly or indirectly, by computer applications currently in any stage of active consideration. One major point to be made is this; that the systems engineering group, in all its work, should make maximum use of project work on the part of existing line and staff organizations.

It has been our experience that, once this policy has been adopted and a little work has been done along this line, the total result is a significant increase in the pace and extent of work that can be accomplished by a given staff in a given length of time. Ancillary benefits are also important. Not only do people in line organizations tend to support the application program more fully as a result of their direct participation, but also their experience and knowledge of important details of present systems can be infused more easily and fully into the early stages of research and new-system development.

From a paper entitled, "Management Sciences In Support of A Computer Application Program" presented at the Third Annual International Meeting of the Institute of Management Sciences in Los Angeles, Oct. 1956.

Frequent time adjustments are no problem with the dial head available on AGASTAT time/delay/relays. They provide a complete range of adjustment with 1 revolution of the dial. Dial markings permit easy calibration for accurate adjustment. And you can spot each of the 4 timing ranges quickly because they are color coded: blue from 30 seconds to 15 minutes; red from 10 seconds to 2 minutes; yellow from 0.1 to 10 seconds; white from 0.1 to 3 seconds.

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TOWARD A BETTER LIFE

By RALPH V. COLES
General Manager, Fielden Instrument Div.
Robertshaw-Fulton Controls Co.

THE WORD AUTOMATION was first used in 1947 by D. S. Harder, Ford Motor Co. vice president, to describe the automatic handling of parts between progressive production processes. Since that time, it has come to mean a great deal more. I prefer to think of automation as including all technical devices leading to the development of machinery for judgment. For an all inclusive definition, it is: "A contemporary group of independent advances in the field of mechanization which characteristically employ discriminatory devices and automatic controls, including transfer machinery, automatic assembly, the whole field of control engineering and that part of communication engineering concerned with data processing, accountancy and calculation involving the use of electronic computers."

Three Forms of Automation

An essential feature of automation is the idea of linking a sequence of operations into a continuous process without manual handling. In newer continuous processes, such as oil refining, the material flows through a succession of stills, columns and reactors until it emerges as a complete product. The condition of the material at any point in the continuous process is critically important. Instruments are installed to keep the operator informed and enable him to make adjustments if conditions are not right. The use of automatic controls to carry out these adjustments by feeding back signals, followed quickly and naturally. Oil refineries are approaching the point where 20 per cent of their capital cost is for these controls. Costly plant units may be operated continuously with no more than two operators per shift —two because one might become ill.

Transfer machining or "Detroit automation," as it is sometimes known, refers to non-process industries. However, while certain parts of cars such as cylinder blocks and pistons are now made automatically, the car itself is still

put together by hand.

Complete redesigning of the product has been necessary to make automatic assembly an economic process. The electronics industry is cited as an example. To automate many industries entirely new concepts will have to be evolved.

The third form of automation lies in the field of computers and office machines. In addition to carrying out repetitive and complex calculations quickly, automation devices are being used for payrolls, inventory control, etc.

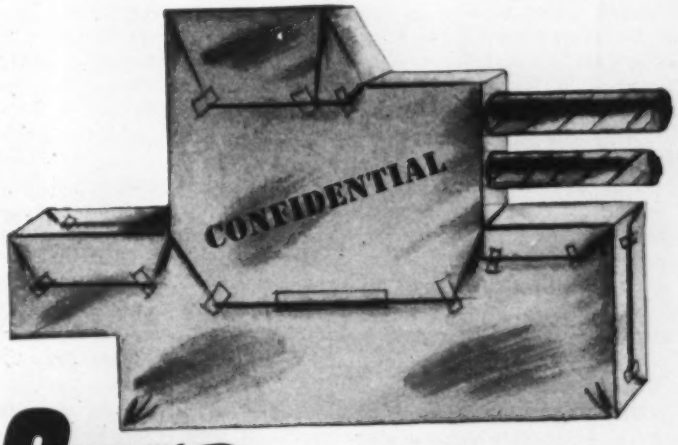
There are four basic reasons why industry and commerce adopts automation: (1) Products can be made cheaper; (2) Products can be made better; (3) Industrial processes can be made safer; and (4) It makes possible certain processes heretofore impossible.

Of greater importance is the economic reason for automation—the need for greater productivity. Forecasts of all the economists, both government and private, see our gross national product expanding by 40 per cent in the next 10 years. In those 10 years our labor cannot expand by more than 14 per cent. To achieve this output with only a 14 per cent increase in work force, each worker must produce 25 per cent more than he does today. It is obvious that we can only accomplish this by adopting mechanization and automation in an ever increasing degree.

Social Considerations

Fears have been expressed regarding the social and economic upheaval that will be caused by automation—that we are to become a nation of machine minders, utterly dependent on our robots. Thus, in fact, becoming robots ourselves. This, of course, is the sheerest rubbish.

Due to a complete miscalculation regarding future requirements of engineers and technologists since the war, far too few young people have been directed toward scientific occupations. Twice as many engineers were graduated in 1950 as in 1955. There is a steadily worsening condition in our high schools. One-fourth of all American high schools offer no chemistry, physics and geometry. The number of graduating teachers qualified to instruct mathematics has fallen 50 per cent since 1951.



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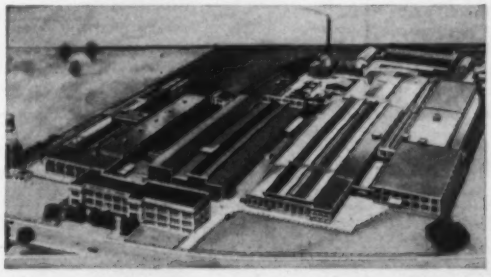

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In contrast, every student in the Soviet Union leaving the 10 year school system has had 10 years of mathematics, 6 years of biology, 5 years of physics and 4 years of chemistry. The English Government plans to spend in the neighborhood of $500 million to double the output of technologists and technicians in schools comparable to our high schools. This shortage of trained personnel is to my mind the most vital problem facing America today.

Role of Computers

Electronic computers in the future will enter more directly into the production field. They will be used to control processes and co-ordinate various departments, as well as work out optimum stocks of material and work in progress. Master controllers might even take into account external problems such as changes due to seasonal demands. Computers will replace man because the human brain cannot assimilate and store facts quickly enough or long enough. Human beings are subject to emotion and nonsignificant noise. They tire. Computers have none of these shortcomings. There is not a single industry in the industrial classification that is not now using instruments and controls to some degree. It is an absolute certainty that more could be used in the engineering industry, process industry and miscellaneous manufacturing industries. It is not going to be necessary to have long runs of a given product to justify some degree of automation. Even specialty manufacturers have to increase productivity. Relatively inexpensive devices will enable some manufacturers to continuously gage their products without stopping their machines. This eliminates starting and stopping which uses up half of a machine's operating time. Through electronic amplification, devices can be applied to readjusting the machine automatically. While cutting downtime, production is increased many times.

In a multiproduct plant, maximum productivity might be obtained by ruthless selection of work and a total disregard for priorities. Hence, the needs of the customer are disregarded and a loss of good will results. Production control must be arranged to give maximum service and also maximum productivity. Automation is not going to side-step the multiproduct plant which in many cases is a smaller manufacturer. Here is where a computer service, from which smaller factories will be able to rent machines and experts to man them, can be used to obtain maximum productivity and customer satisfaction—and compatibility between the two.

Economists are coming to realize that booms and depressions are the "hunting" of an improperly adjusted servomechanism of society.

We can all help by promoting the benefits of automation with the knowledge that it holds a better and more prosperous life ahead.

From a paper presented before the Pittsburgh branch of the National Industrial Advertisers Association in Pittsburgh, Pa., Nov., 1956.

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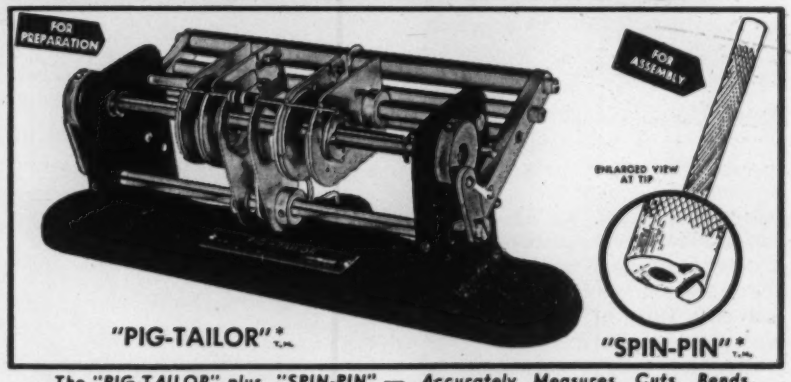
. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



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* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. A-3P

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AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D. C.

LIQUID METERING DEVICE

Variable displacement metering device for measuring and dispensing liquid charges includes electrically actuated means for controlling the displacement in accordance with the temperature of the liquid so as to maintain uniform charge weights. Patent 2,775,870 by Ralph E. Bruce and Roger M. McClung, assigned to Production Control Units Inc.

BATCHING SCALE CONTROL CIRCUIT

Cutoff circuit for an automatic weighing scale, having a weight indicator and controlling a feeding means, includes relays arranged to operate the feeding means at high and slow speeds. Patent 2,776,103 by Robert O. Bradley, assigned to Toledo Scale Co.

AUTOMATIC SOLIDS HANDLING SYSTEM

Arrangement for handling finely divided solids utilizes a vacuum system and a compressed air system. Transfer between the two systems is regulated through valves actuated by automatic timing means. Patent 2,776,171 by Lauritz E. Mylting, assigned to the Allen-Sherman-Hoff Co.

WELDING MACHINE

In a welding device including means to support the welding rod and move it into and out of engagement with a workpiece, a filelike element is mounted along the path of motion of the rod end to remove crusted flux before the end engages the workpiece. Patent 2,777,938 by Werner G. Hess, assigned to Dana Corp.

APPARATUS FOR CONTINUOUSLY FORMING PLASTIC TUBING

Forming of tubing is accomplished by wrapping a strip of plastic material around a mandrel which carries endless conveyor elements that extend along the axis of the mandrel to provide an external surface for tube forming. The return portions of the conveyor elements run inside the mandrel. Patent 2,777,501 by Herbert C. Fischer, assigned to National Fibre Glass Co. Inc.

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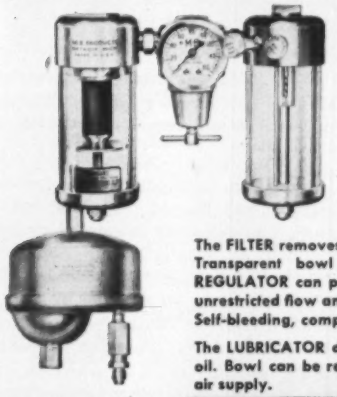

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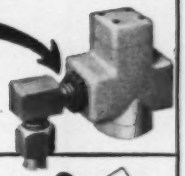

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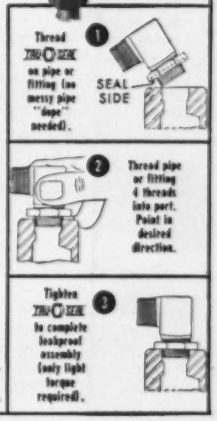
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Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
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AUTOMATION

Paperbound, 106 pages, 6 by 9½ inches; illustrated; published by Her Majesty's Stationery Office, London; available from York House, Kingsway, London W. C. 2; about 85 cents.

The concept of automation, technical trends, extent and rate of development, and impact on management and labor are surveyed and concisely discussed in this report by the Department of Scientific and Industrial Research. Technical trends are reviewed under the topics of: automatic machining as an example of manufacturing developments, automatic control of processes, and automatic processing of data. Cost figures comparing some automated installations with previous operations are included, as well as diagrams and photographs of automatic equipment and installations.

PRODUCTION CONTROL

By William Voris, Div. of Business and Economics, Los Angeles State College; 413 pages, 6 by 9 inches, illustrated, clothbound, published by Richard D. Irwin Inc., Homewood, Ill.; available from AUTOMATION; *$7.20 postpaid.*

Aspects of production control in automated installations are considered, following discussions of the function of production control, relationships to other manufacturing functions, and applications in intermittent and continuous manufacturing. Use of computers, operations research and linear programing are described. Case histories, illustrations of forms, and case problems are used throughout the text to provide practical examples of production control applications.

BASICS OF PHOTOTUBES AND PHOTOCELLS

By David Mark; 128 pages, 5½ by 8½ inches, illustrated, paperbound, published by John F. Rider Publisher Inc., New York; available from AUTOMATION; *$2.90 postpaid.*

This book presents three aspects of photoelectricity —the photovoltaic effect, the photoconductive effect and the photoemissive effect—and describes known principles and historical steps in their discovery. Characteristics of photoconductive cells, photovoltaic cells, phototubes and photocurrent amplifiers are discussed and applications of such equipment in instruments and commercial uses are illustrated. Applications include sketches of equipment arrangements, block diagrams of circuits and schematic circuit diagrams. The text is not written in stilted technical form and should be very useful to anyone seeking basic information on photoelectricity.

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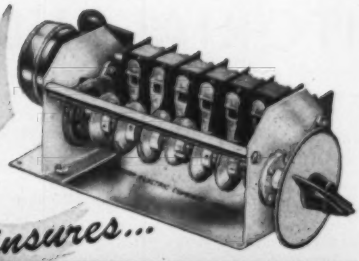

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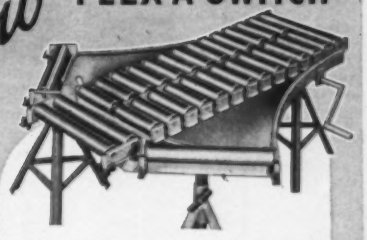

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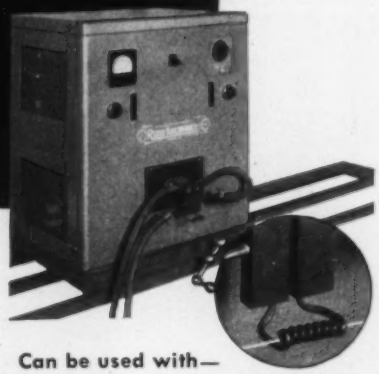

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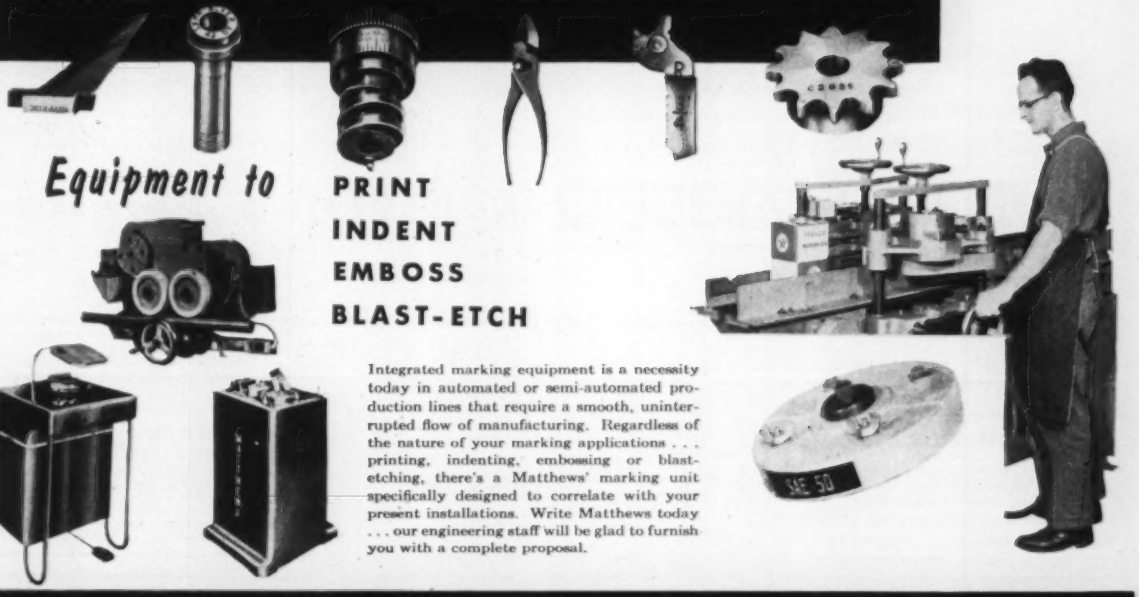

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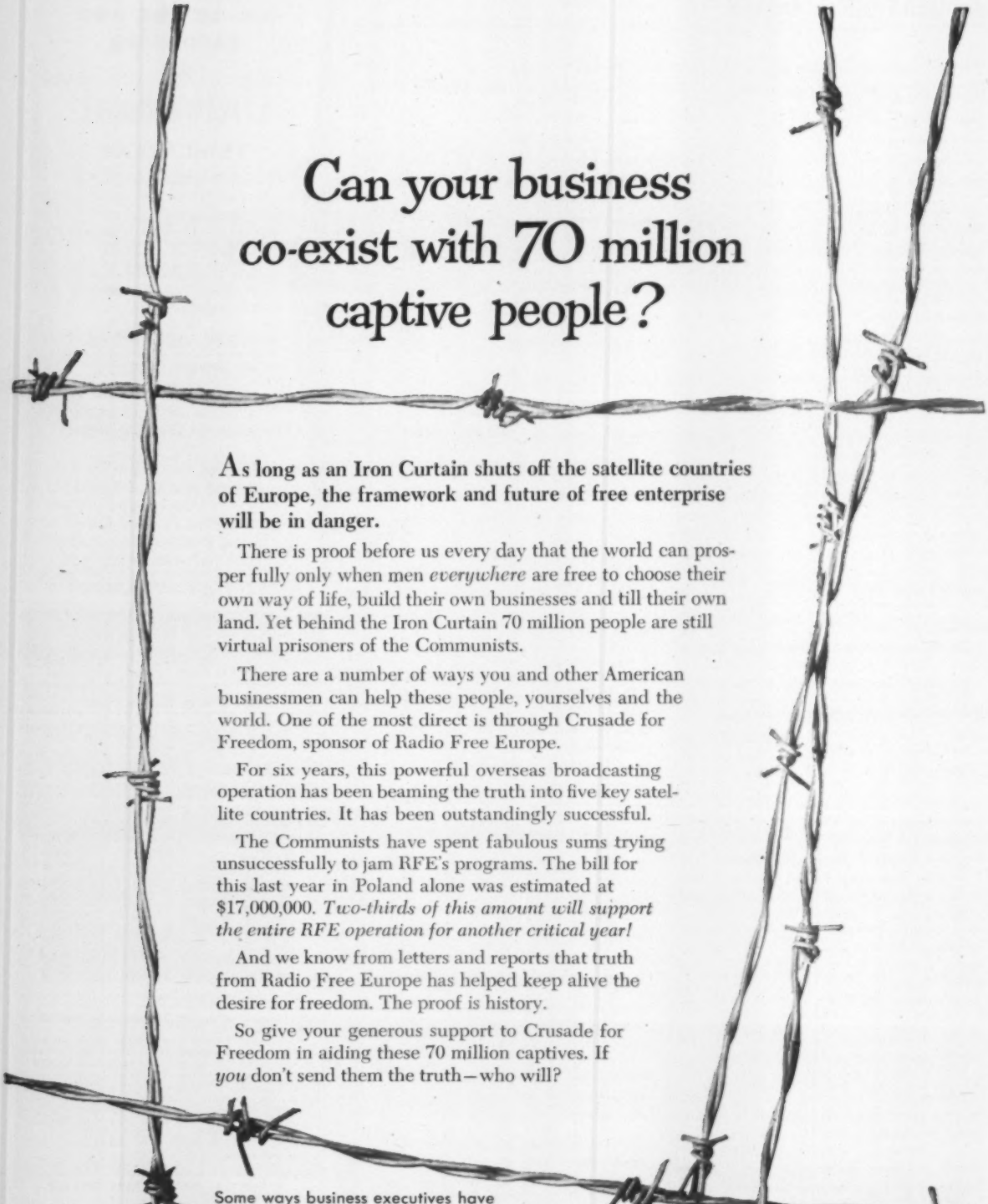

As long as an Iron Curtain shuts off the satellite countries of Europe, the framework and future of free enterprise will be in danger.

There is proof before us every day that the world can prosper fully only when men *everywhere* are free to choose their own way of life, build their own businesses and till their own land. Yet behind the Iron Curtain 70 million people are still virtual prisoners of the Communists.

There are a number of ways you and other American businessmen can help these people, yourselves and the world. One of the most direct is through Crusade for Freedom, sponsor of Radio Free Europe.

For six years, this powerful overseas broadcasting operation has been beaming the truth into five key satellite countries. It has been outstandingly successful.

The Communists have spent fabulous sums trying unsuccessfully to jam RFE's programs. The bill for this last year in Poland alone was estimated at $17,000,000. *Two-thirds of this amount will support the entire RFE operation for another critical year!*

And we know from letters and reports that truth from Radio Free Europe has helped keep alive the desire for freedom. The proof is history.

So give your generous support to Crusade for Freedom in aiding these 70 million captives. If *you* don't send them the truth—who will?

Some ways business executives have helped. Check the ones you are interested in.

- ☐ Display Crusade material on your company bulletin board.
- ☐ Plan a paycheck stuffer to inform your employees of the importance of the Crusade for Freedom.
- ☐ Plan to conduct an in-company solicitation.
- ☐ Match employee funds with *your Truth Dollars.*

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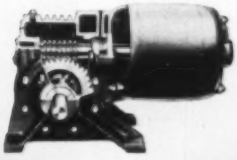

ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

You look at a motor application in an ad, and 99 times out of a hundred first thing you say is, "But my problem's different." Here, it's 100 to one you'll be right.

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And Master can deliver the goods for *you!* Master components can be integrated in any combination to give you the right horsepower, right shaft speed, right mounting features, in a single, efficient compact unit. See Master for your drives!

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Speeds	Single-speed, multi-speed, and variable speed.
Installation	Horizontal and vertical, with or without flanges and other features.
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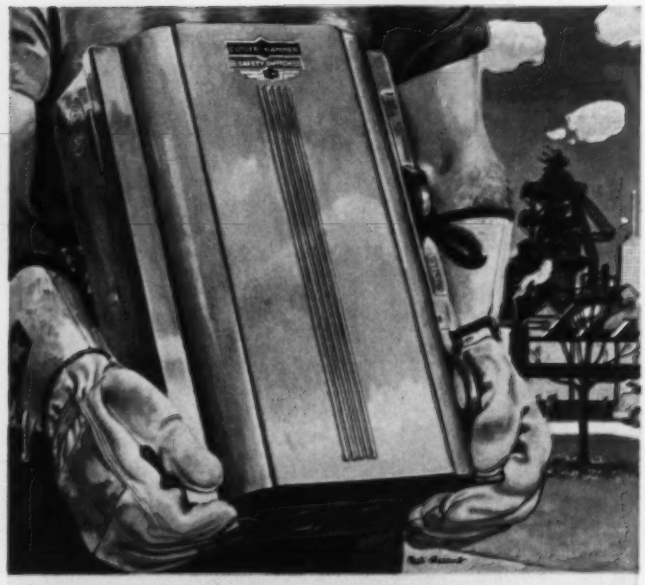
This Safety Switch is Built to Match the Performance of the Finest in Motor Control

☆ *installs easier*

☆ *works better*

☆ *lasts longer*



A Safety Switch Worthy of its Name
Cutler-Hammer 4105. Type A. 30 to 1200 Amp.

Engineered for "heat-proof" dependability. New design for minimum internal heat generation; new materials for heat immunity.

Automatic pressure fuse receivers; no screws to forget to tighten . . . no screws to loosen in service by alternate expansion and contraction.

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Panel mounted mechanism of the Cutler-Hammer 4105 Safety Switch is readily interchangeable with that of the Cutler-Hammer 4101 to permit replacements without case and conduit work.

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Such control equipment brings important dependability and savings to any job. But it should be matched with a safety switch designed and built to equal the performance. That is exactly what the Cutler-Hammer 4105 Safety Switch offers. It is loaded with advanced design features. See it. Try it. Prove it. Order from nearby Cutler-Hammer Distributor today. CUTLER-HAMMER, Inc., 1466 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

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MOTOR CONTROL
C-H

Cutler-Hammer Three-Star Motor Control can now be obtained in every needed form

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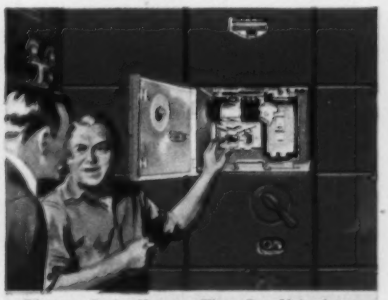

The new Cutler-Hammer Three-Star Unitrol provides for the quickest installation or rearrangement of the finest in control equipment, C-H Three-Star Motor Control.

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